Preliminary Environmental Impact Assessment (PEIA)
Greece
Trans Adriatic Pipeline – TAP

Document Title:
Greek Preliminary Impact Assessment

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Annex VII - Emissions Dispersion Modeling
ABBREVIATIONS

AA    Annual Average
AFP   Active Fire Protection
ALARP As low as reasonable practicable
BAP   Biodiversity Action Plan
BAT   Best Available Technique
BCM   Billion Standard Cubic Metres
BREF  Best Available Techniques Reference Documents
BVS   Block Valve Stations.
CH    Cultural Heritage
CHM   Cultural Heritage Management
CHMP  Cultural Heritage Management Plan
CS    Compressor Station
CSR   Corporate Social Responsibility
DCM   Decision of Council of Ministers
DDT   Dichlorodiphenyltrichloroethane
E.ON  A Shareholder of TAP
EAPTH General Directorate of Environment / Division of Air Quality
EAA   European Association of Archaeologists
EBRD  European Bank for Reconstruction and Development
EC    European Community
EU    European Union
EHS Guidelines Environmental, Health, and Safety Guidelines
EIA   Environmental Impact Assessment
EIS   Environmental Impact Statement
ENT   E.ON New Build & Technology (a subsidiary of E.ON)
EPA   Environmental Protection Agency (US)
EQS   Environmental Quality Standards
ERM   Environmental Resources Management
ESD   Emergency Shutdown
ESIA  Environmental and Social Impact Assessment
ESMP  Environmental and Social Management Plan
Espoo Convention UN Convention on Environmental Impact Assessment in a Transboundary Context
ETA   Environmental Terms Approval
EU    European Union
EYPE  Ministry of Environment / Special Environmental Service
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<td>Fire and Explosion Risk Assessment</td>
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<td>FEED</td>
<td>Front-End Engineering and Design</td>
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<td>FI</td>
<td>Financial Intermediary</td>
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<td>FYROM</td>
<td>Former Yugoslav Republic of Macedonia</td>
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<td>Greenhouse Gas</td>
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<td>Hazard Identification</td>
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<td>Hazard and Operability</td>
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<td>Institute of Field Archaeologists</td>
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<td>IFC</td>
<td>International Finance Corporation</td>
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<td>ILO</td>
<td>International Labor Organization</td>
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<td>IPPC</td>
<td>Integrated Pollution Prevention and Control</td>
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<td>IUCN</td>
<td>International Union for the Conservation of Nature</td>
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<td>JMD</td>
<td>Joint Ministerial Decision</td>
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<td>LNG</td>
<td>Liquefied Natural Gas</td>
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<td>LPD</td>
<td>Large Projects Department (Ministry of Culture)</td>
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<td>LRP</td>
<td>Livelihood Restoration Plan</td>
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<td>MAC</td>
<td>Maximum Allowable Concentration</td>
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<td>MEECC</td>
<td>Ministry of Environment Energy and Climate Change</td>
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<td>MOP</td>
<td>Maximum Operating Pressure</td>
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<td>NG</td>
<td>Natural gas</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Act</td>
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<td>NGO</td>
<td>Non Governmental Organization</td>
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<td>NLC</td>
<td>National Licensing Centre</td>
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<td>OHS</td>
<td>Occupational Health and Safety</td>
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<td>PAH</td>
<td>Polyaromatic Hydrocarbons</td>
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<tr>
<td>PCDP</td>
<td>Public Consultation and Disclosure Plan <em>(identical with SEP)</em></td>
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<td>PEIA</td>
<td>Preliminary Environmental Impact Assessment and Evaluation</td>
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<td>PFP</td>
<td>Passive Fire Protection</td>
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<td>PPC</td>
<td>Public Power Corporation of Greece</td>
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<tr>
<td>PPS</td>
<td>Pipeline Protection Strip (8 metres)</td>
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<tr>
<td>PM</td>
<td>Particulate Matter</td>
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<tr>
<td>PR</td>
<td>Performance Requirement (EBRD)</td>
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<tr>
<td>QRA</td>
<td>Quantitative Risk Assessment</td>
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<tr>
<td>RAP</td>
<td>Resettlement Action Plan</td>
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<td>REA</td>
<td>Regional Environmental Agency</td>
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### Greek Preliminary Impact Assessment

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<td>Right of Way</td>
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<td>Social and Environmental Investments</td>
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<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
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<td>VCE</td>
<td>Vapor Cloud Expansion</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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</tbody>
</table>
1 NAME AND TYPE OF DEVELOPMENT

Project: Construction and operation of the Greek section of the Trans Adriatic Pipeline (TAP) – hereinafter known as ‘the Project’.

The TAP is being developed by Trans Adriatic Pipeline AG (TAP AG), a company registered in Switzerland, which is a joint venture of three shareholders - Statoil (Norway), EGL (Switzerland) and E.ON Ruhrgas (Germany).

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Contact person: Stathis Theodoropoulos, Senior Country Consultant

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Fax: (+30) 210 7454300
Email: Stathis.Theodoropoulos@tap-ag.com

Type of Development: This study comprises the Preliminary Environmental Impact Assessment of the section of the TAP in Greece which stretches from Nea Messimvria (north-west of Thessaloniki) to the Albanian border. The study includes the pipeline itself as well as block valves along the route and one potential compressor station near the border to Albania.

It is further envisaged that the TAP Project will be expanded to the east to include a section from Nea Messimvria to Komotini (located in East Macedonia and Thrace Region) which will mainly follow existing pipeline routes. For this additional section, an Environmental Pre-licence has already been issued by the Special Environmental Service of the Ministry of Environment Energy and Climate Change. Additional information that will be required to integrate this new section into the TAP Project will be submitted to the authorities at a later date with a view to providing a full ESIA report that includes the complete route: Komotini to the Albanian border.

The TAP Project is a natural gas pipeline project with a diameter of 48 inches (1.2 m), will start in Greece, cross Albania and the Adriatic Sea and come ashore in southern Italy, allowing gas to flow directly from the Caspian region to European markets. The Greek section of
the Project, as described in this document, i.e. between Nea Messimvria and the Albanian Border, will be approximately 181 km long.

The Albanian and the Italian sections of the TAP (inclusive of the offshore crossing of the Adriatic sea) are subject to separate assessments which will be submitted to the competent authority in each of the respective countries.

In Greece the Project type is classified in the 1st Subcategory of the 1st Category of the 10th Group of projects (Special Projects), according to JMD 15393/2332/02 (GG 1022/B/05.08.02). Therefore, it is subject to Preliminary Environmental Assessment and Evaluation according to Art. 3 of Chapter A of JMD 11014/703/03 (GG 332/B/20.03.03) and the provisions of L.3010/2002 and L.1650/1986. Further, provided that a positive Preliminary Environmental Assessment and Evaluation (so-called Environmental Pre-licence) is issued by the competent authority, a full Environmental Impact Assessment will subsequently be prepared. The competent authority in charge of the environmental assessment process is the Special Environment Service of the Ministry of Environment, Energy and Climate Change (MEECC).

While the Greek regulatory framework refers to Environmental Impact Assessment (EIA) only, TAP AG is also looking at the social implications of the Project as per international best practice. Through the Environmental and Social Impact Assessment (ESIA) process TAP AG identifies, addresses, and manages all social, environmental and cultural heritage impacts, risks and opportunities in a systematic and comprehensive manner. TAP AG has selected the Performance Requirements (PR) of the European Bank for Reconstruction and Development (EBRD) to serve as the benchmark to assure that adverse impacts on people, their rights, livelihoods, culture and environment are avoided or, where avoidance is not possible, minimised, mitigated, offset and/or compensated. This approach will further assure compliance with European Union (EU) Directives and Regulations and the Performance Standards (PS) of the International Finance Corporation (IFC).

Taking the precautionary approach, for the purpose of the ESIA process, the TAP Project is being treated as a Category A project with
regards to the categorisation of the EBRD Environmental and Social Policy\(^{(1)}\). This categorisation means that the Project will undergo a comprehensive environmental and social impact assessment process and relevant measures to safeguard the environment including the social sphere will be set out in an environmental and social management plan.

The TAP offers a new gas transportation route between the Caspian Region and southern and central Europe that will support Europe in achieving its strategic goal of securing and diversifying gas supplies and boosting its ability to meet growing energy needs.

The TAP has been designed with the aim to maximise efficiency and flexibility of gas supply to Europe. The pipeline transportation capacity may be increased from an initial throughput of 10 BCM/year\(^{(2)}\) to 20 BCM/year. For the 10 BCM phase only two Compressor Stations (CS00 in Greece - on the section between Komotini and Nea Messimvria, and CS03 in Albania near the Adriatic coast) are required. Two additional compressor stations (CS01 and CS02) shall be added to increase the throughput from 10 BCM to 20 BCM. For the 10 BCM phase CS02 will only act as metering station. The location of CS02 is currently under examination. Subject to further, more detailed system studies, it will be either located on the Albanian side, or as an option on the Greek side of the border. This PEIA presents the potential CS02 site options that have been identified in Greece.

The Greek section of the TAP, as described in this document, is located in the regions of Central and West Macedonia.

TAP AG identified a preliminary pipeline route of approximately 181 km in length that starts with a Block Valve station southwest of the settlement of Nea Messimvria (north-west of Thessaloniki) and crosses

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\(^{(1)}\) A proposed project is classified as Category A when it could result in potentially significant and diverse adverse future environmental and/or social impacts and issues which, at the time of categorisation, cannot readily be identified or assessed and which require a formalised and participatory assessment process carried out by independent third party specialists in accordance with the PR [cf. para. 20 EBRD Environmental Policy 2008]; Further, Appendix 1 EBRD Environmental Policy provides an indication of Category A projects. This includes under para. 8. “ Pipelines, terminals and associated facilities for the large-scale transport of gas, oil and chemicals”.

\(^{(2)}\) BCM = billion cubic metres
into Albania west of the settlement of Ieropigi. The associated facilities of the pipeline system includes approximately additional 7 block valve stations on route and potential take-off points in the vicinity of the cities of Kastoria, Ptolemaida and Florina. A potential site for the location of Compressor Station (CS02) is being considered to the west of Mesopotamia.

The Study Team: The PEIA was developed by EXERGIA in collaboration with Environmental Resources Management (ERM), an international environmental and social consultancy, and ILF, the route engineering consultant, during the period of November 2010 to August 2011.

Study Area: The preliminary impact assessment presented in this PEIA has focussed on a 2 km wide corridor (i.e. 1 km either side of the proposed centre line) along the entire length of the preferred route (also referred to as the ‘Base Case’ route). The 2 km wide corridor is referred to as the ‘Study Area’ throughout the PEIA.

Signature / Stamp

(Exergia S.A., Kostas Batos)
2 NON TECHNICAL SUMMARY

2.1 INTRODUCTION

This chapter presents the Non-Technical Summary of the Preliminary Environmental Impact Assessment (PEIA) for the Greek part of the Trans Adriatic Pipeline (TAP) project for the section Nea Messimvria to the Greek-Albanian border, and is intended for the non-specialist readers.

The PEIA is a precursor step to a detailed Environmental and Social Impact Assessment (ESIA) in which TAP AG will identify and provide means to addresses and manage all social, environmental and cultural heritage impacts, risks and opportunities associated with the construction and operation of the TAP project in Greece, in a systematic and comprehensive manner.

The Albanian and the Italian sections of the TAP (inclusive of the offshore crossing of the Adriatic Sea) are subject to separate assessments in each country.

2.2 THE TRANS ADRIATIC PIPELINE

The TAP is a proposed natural gas pipeline in the so-called Southern Gas Corridor that will bring gas from new reserves in the Caspian region to Southern and Central Europe. The term is used by the European Commission to describe planned infrastructure projects bringing gas from the Caspian and Middle Eastern sources to Europe, aimed at improving security of supply. The TAP Project supports Europe in achieving its strategic goal of securing further gas supplies and meeting growing energy needs. The TAP Project offers a realistic opportunity in the form of an alternative transportation route which will open the Southern Gas Corridor. It will be the shortest gas transit route of all the European pipeline projects currently being supported by the EU within the Southern Corridor.

The pipeline will connect to existing gas networks, starting in Greece, crossing Albania and the Adriatic Sea and coming ashore in southern Italy. It will allow gas to flow directly from the Caspian basin into European markets.

The TAP will contribute to the security and diversity of Europe’s energy supply by providing the necessary infrastructure to transport gas from the Shah
Deniz II field in Azerbaijan via the most direct route to Southern Europe when production begins in early 2018. As more gas becomes available, the TAP will have the capacity to cater for an additional 10 Billion Standard Cubic Meters (BCM) per annum of new gas, expanding to 20 BCM as required.

The TAP Project is supported by financially stable and strong shareholders. TAP AG’s shareholders are Swiss EGL (42.5%), Norwegian Statoil (42.5%) and German E.ON Ruhrgas (15%). The TAP Project will require no funding from subsidies or from any of the governments of the host countries. The TAP can deliver substantial benefits in terms of significant investment to the countries through which it passes. The European Union recognised the project under the so-called TEN-E (Trans-European Energy Networks) guidelines as a Project of Common Interest for the European Union’s overall energy policy objectives.

The TAP Project is among the major investments in energy infrastructure in Greece, with significance that extends beyond the Greek borders. At a geostrategic level, the Project is a logical element in the value chain, connecting existing and planned grids for natural gas transport in Southeast Europe with gas systems in Western Europe via Italy, the Adriatic Sea and Albania. The pipeline will therefore give Europe better access to the major reserves of natural gas located in the Caspian region, Russia and the Middle East. At a national level, the Project will strengthen the role of Greece as an energy player in Southeast Europe and the Balkans. At a local level, the proposed route, as well as the specific siting of associated installations, has been the result of thorough balancing amongst a number of viable alternatives.

2.3 PROJECT DESCRIPTION

The TAP Project in Greece, as described in this PEIA document (the ‘Project’), will be entirely located onshore and will have a length of approximately 181 km. It will start near Nea Messimvria (north-west of Thessaloniki), head towards the west and cross into Albania south-west of the settlement of Ieropigi.

Figure 2-1 shows the TAP route in Greece, as described in this document, i.e. from Nea Messimvria to the Albanian border. The figure shows the 2 km wide Project routing corridor (1 km either side of the proposed centreline).
Figure 2-1  The TAP Route in Greece

It is further envisaged that the TAP Project will be expanded to the east to include a section from Nea Messimvria to Komotini which will mainly follow existing pipeline routes. Additional information that will be required to integrate this new section into the TAP Project will be submitted to the authorities at a later date with a view to providing a full ESIA report that includes the complete route in Greece: Komotini to the Albanian border.

The pipeline will be 48 inches (1.2 m) in diameter and will be made of welded steel pipe sections ranging between 8 and 18 m in length. The design pressure will be 95 bar gauge (barg). The pipeline will be coated both inside and outside. The internal coating will be an epoxy resin which reduces friction, whilst the external coating will be 3-layer polyethylene to protect the pipeline from corrosion. Some of the pipeline sections will be additionally coated with reinforced concrete to protect the pipe from external damage. The entire pipeline will be protected against corrosion by a cathodic protection system.

In Greece the pipeline will be buried along the entire length of the Project route. For safety reasons and in order to minimise impacts to existing land uses (e.g. agricultural) the buried pipeline will have a minimum soil cover of
1 m. Greater depths of soil cover will be required when crossing existing infrastructure.

The TAP pipeline will be designed for a technical life time of 50 years. The design life for equipment and piping of the stations is 25 years. The design shall assure that the gas transport system fulfils all safety requirements of the base National and European Codes and Standards. The pipeline will be assembled in a conventional way as a construction spread that moves along the Project corridor. This comprises that first, the top soil is stripped away and stored separately, and then a trench is excavated. Individual 8 to 18 m long joints of pipe will then be welded to the pipeline string which is subsequently lowered into the trench. The soil is placed back into the trench and the land reinstated while the construction spread progresses forward.

The pipeline transportation capacity will be increased from an initial throughput of 10 billion cubic meters per year (BCM/year) to 20 BCM/y. Compressor stations are required to transport the gas by increasing the pressure in the pipeline. For the 10 BCM phase only two Compressor Stations (CS00 in Greece, on the Komotini - Nea Messimvria section, and CS03 in Albania) are required. The upgrade to 20 BCM will require two additional Compressor Stations, CS01 on the Komotini – Nea Messimvria Section and CS02, as identified in Figure 2-1. For the 10 BCM phase CS02 will only act as metering station. Depending on further technical system studies, CS02 will be either located in Albania near the Albania/Greek border or as an option in Greece near the border to the north-west of Kastoria. The exact location of CS02 will be based on detailed gas flow and pressure drop calculations along the pipeline system. In case that CS02 would be installed in Greece, the preferred site is located approximately 2 km to the west of Mesopotamia.

The compressor stations mainly comprise facilities for gas treatment (filter separators), metering, compression and cooling. The footprint of a compressor station installation is estimated to be a fenced area of approximately 41 hectares (ha) including a safety buffer zone. Compressor and cooling facilities will be installed at CS02 for the 20 BCM phase only.

The Project will also include the installation of Block Valve Stations (BVS). With these valves the operator can isolate segments of the pipeline for maintenance work or isolate a rupture or leak. The block valves are unmanned and comprise a small building with a fence around them to avoid any interference, covering a total surface area of approximately 20 m by 30 m. In
line with international best practice, these stations will be placed in regular intervals of around 30 km along the pipeline route, with the key equipment being installed underground. Subject to further detailing of planning, approximately 7 BVS are envisaged between Nea Messimvria and the Albania border.

The pipeline will be monitored and controlled from remote via a central control room in accordance with the operating philosophy developed by TAP. Based on technical factors, the central control for the TAP system is foreseen to be located at the dispatching facility in Italy.

During operation, any leaks will be detected through the continuous monitoring of pressure and flow rates at the pipeline inlet and outlet. If a leak is detected, emergency shutdown procedures will be carried out. To allow internal inspection, ‘pigging’ facilities (by Pipeline Inspection Gauge) will be installed. The pipeline system has been designed to allow use of instrumented ‘pigs’, if necessary.

2.4 ALTERNATIVE SOLUTIONS CONSIDERED

Through the framework of a route appraisal and refinement process that was based on identifying and aiming to avoiding constraints\(^1\), a number of alternatives were investigated with regard to the pipeline route and the location of the necessary supporting installations.

A summary of the alternatives considered and the selection process for the preferred route and project layout including compressor station sites is given below.

2.4.1 Pipeline Route

The process of pipeline route selection was undertaken in several iterative stages in a route refinement process. Initially, two main routing corridors, referred to as the Northern Corridor and Southern Corridor were identified between Nea Messimvria and the Albanian border within a 50 km wide search

\(^1\) The route refinement process preceded the PEIA, with the aim to narrow down the initial 50 km-wide project corridor to a 2 km-wide corridor, which would form the basis for the PEIA, and defines a number of viable alternatives. The alternatives assessment study was conducted between Autumn 2010 and Spring 2011.
corridor between Nea Mesimvria and der border with Albania. These were determined by consideration of general topography and main constraints such as protected sites, the possibility to bundle with existing infrastructure and technical and logistical considerations. For each corridor a number of routes and sub alternatives were developed aiming at avoiding or minimising interactions with the main environmental, social and cultural heritage constraints namely: protected areas, settlements incl. land use planning and known cultural heritage sites. As a result, a set of routing alternatives was identified (cf. Figure 2-2).

![Diagram showing routing alternatives in Greece](image)

**Figure 2-2** Overview of routing alternatives studied in Greece

A technical, environmental, socioeconomic and cultural heritage baseline characterisation and appraisal of these alternatives was then conducted through a combination of desk top studies and field inspections. For each alternative, a 2 km wide corridor (1 km both sides of the centreline) was investigated. Impact indicators of the environmental, socioeconomic and cultural heritage characteristics of each alternative were established to highlight the key critical potential features.
In a comparative evaluation of these routing options, two routes were identified as the main alternatives (cf. Figure 2-3):

- The Base Case (Northern Route); and
- The Southern Alternative $S_a$.

![Main Routing Alternatives of the TAP in Greece](Image)

**Figure 2-3** Main Routing Alternatives of the TAP in Greece

The northern route corridor starts from Nea Messimvria, near the DESFA compressor station, and follows a western direction through the Municipalities of Chalkidona, Pella, Skydra, Naousa and Edessa. The route then turns to the south through the Municipality of Eordea and then again to the west crossing the Municipalities of Aminteo, Kastoria, Orestidos, Nestorio and Alexandria prior to reaching the border. Due to route changes in Albania that occurred in the course of the planning process, the most western section of the Base
Case on the Greek side was subsequently adapted and now crosses the border south-west of Ieropigi village1.

The southern alternative $S_0$ has the same starting points as the Northern Route, but it heads towards the southwest, following to a large extent the Egnatia Highway. It crosses the Municipalities of Chalkidona, Pella, Alexandria, Veroia, Kozani and Voio. South of Siatista, then turns towards the northwest to cross the Municipalities of Orestida, Kastoria and Nestorio before reaching the Albanian border crossing.

The main environmental, socioeconomic and cultural heritage characteristics of the Base Case Route and Alternative $S_0$ are presented in Table 2-1 below.

Table 2-1  **Main Environmental, Socioeconomic and Cultural Heritage Characteristics of the Base Case and Alternative $S_0$**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Base Case</th>
<th>Alternative $S_0$</th>
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</thead>
<tbody>
<tr>
<td>General</td>
<td>Most direct route between Nea Mesimvria and the crossing of the Greek/Albanian border west of Kastoria</td>
<td>Longer route which follows in part the route of the Egnatia Highway</td>
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<tr>
<td></td>
<td>Approx. 180 km in length</td>
<td>Approx. 200 km in length</td>
</tr>
<tr>
<td>Environment</td>
<td>Key environmental aspects along the alternative include:</td>
<td>Key environmental aspects along the alternative include:</td>
</tr>
<tr>
<td></td>
<td>The northern slopes of Vermio Mountain which are covered by Fagus and Quercus forests. <em>Castanea sativa</em> and <em>Helleborus odorus subsp. cyclophyllus</em> were also found in the area.</td>
<td>The southern and south-eastern slopes of Vermio Mountain which host a variety of important habitats, such as broadleaved forests and montane and subalpine grasslands and pastures.</td>
</tr>
<tr>
<td></td>
<td>The southern foothills of Verno Mountain with Fagus, <em>Quercus</em> and <em>Pinus nigra</em>.</td>
<td>All alpine and montane meadows and pastures of serpentine substrate as such sites are suitable habitats for many rare flora taxa.</td>
</tr>
<tr>
<td></td>
<td>All montane and alpine meadows and pastures of serpentine substrate</td>
<td>Localised spots within the Thessaloniki – Giannitsa plain (including Axios valley) as they may host colonies of <em>Spermophilus citellus</em>.</td>
</tr>
<tr>
<td></td>
<td>All riverine sites where riparian stands are preserved in relatively good condition.</td>
<td>All riverine sites where riparian stands are preserved in relatively good condition.</td>
</tr>
<tr>
<td></td>
<td>Localised (but currently unknown) spots within the Thessaloniki –</td>
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</table>

(1) The routing has also taken into account the concession area of the Larco nickel mine.
Giannitsa plain (including Axios valley) as they may host colonies of *Spermophilus citellus*.

- The Olympias – Galatea plateau where *Circus pygargus* is reported to breed.

- All riverine crossing sites that preserve water throughout the dry season including the Axios river crossing.

- The Base Case route passes through the NATURA 2000 sites GR1220002 & GR1220010 Axios – Loudias - Aliakmonas Estuaries

- The route is less than 1 km away from the Natura 2000 site GR 1320001 (Lake Kastoria)

- Crosses two wildlife refuges (Flamouria – Grammatiko on Vermio Mt. and Kouri in Eordea plateau)

- Alternative S₀ passes through the following NATURA 2000 sites:
  1. GR1220002 & GR1220010 Axios – Loudias - Aliakmonas Estuaries
  2. GR133002 North Vourinos Mt & Mellia (also an IBA)

- The S₀ alternative passes at less than 1 km away from the Natura 2000 site GR 1210001 while crossing the southern slopes of Mt Vermio.

- The route crosses the following wildlife refuges: Koutsohori, Kouti – Agios Eleftherios and Tservena – Vourinos

- Alternative S₀ crosses the territory of 10 municipalities that includes approx. 12,000 people living within the 2-km corridor. Three of the 10 municipalities have no settlements located within the corridor. There are 52 settlements within the corridor and 63 settlements from which people are potentially using the land and resources within the corridor.

- The population density within the corridor is low. As the route passes to the west across the mountains and ultimately to the Albanian border, the population density gradually drops – from 90 to 100 inhabitants/km² in Chalkidona and Pella to 66 inhabitants/km² in Eordea stands are preserved in relatively good condition. This mainly refers to: Aliakmonas River, Lianovrochi stream and Axios river crossing.
In summary, the northern Base Case route potentially faces fewer challenges in terms of cultural heritage impacts as there are fewer known cultural heritage sites and higher challenges with regards to official planning zones, namely the interactions with the mining concession areas. The Base Case route will cross the Axios Natura 2000 site which is unavoidable (the Natura site stretches North – South, whereas the pipeline runs East to West). The impacts due to the crossing can be minimised by adopting trenchless crossing techniques (micro tunnelling or horizontal directional drilling underneath the protected area). Whereas, southern Alternative S0 faces fewer challenges with regards to official planning zones and potentially higher challenges with regards to cultural heritage due to a higher density of currently know archaeological sites within the corridor. Alternative S0 will also cross the Axios Natura 2000 site which is unavoidable and will further cross a second Natura 2000 site (North Vourinos Mt & Mellia - SPA GR1330002). The impacts due to the crossing of both areas would be minimised by adopting trenchless crossing techniques (micro tunnelling or horizontal directional drilling underneath the protected area).

As a result of the outcomes of the alternatives assessment, TAP AG decided to select the eventually refined Northern route as the Base Case routing for the further planning process in Greece.

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1 The higher number in CH sites along Alternative S0 is in part due to the fact that more field research has been conducted in the vicinity of the alternative.
2.4.2 Compressor Station Locations

According to preliminary layouts, the compressor station premises will be a fenced area of approx. 41 hectares, which includes the safety buffer; the facility installations itself will cover a footprint of about 20 hectares. For the purpose of the site selection, polygons with an extent of approximately 100 hectares (as shown on the maps in the Appendices) were used to provide for some flexibility in the detailing of the site location.

Compressor Station 2 (CS02), will be needed for the full 20 BCM/y pipeline system. In the initial 10 BCM/y case, only a metering station will be established near the border to Albania and this would then be expanded to the CS02 for the 20 BCM/y case. For the base case route, two potential CS02 locations were identified\(^1\). CS02 Alternative D is located approximately 1.5 km east of the Albanian border in the hill lands, approx 3 km to the southwest of Ieropigi village. The preferred CS02 Alternative C, is located approximately 2 km to the West of Mesopotamia town in agricultural plains.

\(^1\) Also the the southern S\(_0\) route alternative a compressor station site (CS2 Alternative site A (CS2a) had been identified in approximately 1.5 km distance to the border on hilly agricultural terrain. Since the preferred route is the northern Base Case route, i.e the Base Case route, the CS2a site is not further discussed.
2.5 BASELINE CONDITIONS OF THE PREFERRED ROUTE (BASE CASE ROUTE)

The Project ‘baseline’ or existing environmental and socio-economic conditions presented in this PEIA have focussed on a 2 km wide corridor (1 km either side of the proposed centre line) along the entire length of the preferred Base Case route. The 2 km wide corridor is referred to as the ‘Study Area’ throughout the PEIA documentation.

2.5.1 Topography and Landscape

The first section of the preferred pipeline route, Base Case, lies on Thessaloniki - Giannitsa Plateau which encompasses the downstream sections of four major river systems: Axios, Aliakmonas, Loudias and Gallikos. This area has a mean altitude of less than 200 m and until the end of 1920s the plateau used to be partially inundated creating the Giannitsa Marsh which covered thousands of hectares. The marsh was drained at the beginning of the 1930s to enable the land to be used for agriculture. Nowadays, the water bodies crossing the plateau are predominantly used for irrigation and are considered to be heavily modified.

Vermio Mountain lies immediately west of the Thessaloniki - Giannitsa Plateau; its highest summit lies above the timberline - approximately 2,000 m above sea level (a.s.l) - nevertheless almost the entire mountain is covered by dense deciduous forests with pine stands being less common. The western slopes of Vermio Mountain face the Eordea Plateau where major urban centres and industrial activities are present.

The Eordea plain lies between 400 – 800 m a.s.l. and is crossed by several tributaries of the Aliakmonas River or streams that flow into the lake systems of the area (Chimaditida, Zazari, Petron and Vegoritida lakes). At the northwest of the Eordea plateau stands Vernon (Vitsi) Mountain which links with Askio (Siniatsiko) Mountain to the southeast and further south to Mount Vourinos. The summits of both Vernon and Askio mountains rise above 2,000 m a.s.l.

To the west towards the Greek-Albanian border and south of Kastoria Lake, the landscape is hilly with patches of cultivated land, grasslands and mixed forests of oak (Quercus spp.) and black pine (Pinus nigra) as well as streams that flow into the upstream section of Aliakmonas River.
2.5.2 Vegetation

The Project corridor hosts a variety of vegetation formations from lowlands to montane areas, including evergreen and deciduous shrubland and forests, riparian forests, dry and wet grasslands and meadows.

The forest habitats found along the proposed route include beech forests (*Fagus sylvatica*), mixed broadleaved forest dominated by oak (*Quercus sp.*) and coniferous forests dominated by pine (*Pinus nigra*). Additionally, riparian forests and galleries are found developing along rivers and streams throughout sections of the Study Area.

Among a number of important plant species found in the Study Area, a total of 65 species are protected by Greek legislation (Presidential Decree 67/81). Among these, eleven are Greek endemics, 17 are Balkan endemics, five are Greek-Albanian endemics, two are Balkan-Anatolian endemics and one is Greek-Anatolian endemic. Moreover, two species are included in the Greek Red Data Book (*Centarea charrellii* CR, *Dactylorhiza incarnata* VU). Further, two species are on the IUCN Red list¹ (*Juniperus excelsa*, *Platanus orientalis*), but these are common in the Greek flora.

2.5.3 Wildlife

Despite the fact that the lowlands crossed by the Project mainly comprise of agricultural land, the areas still host some species of conservation interest.

The brown bear (*Ursus arctos*) has a well-established population in Grammos Mountain area with a maximum of 41 individuals (southwestern part of the Study Area) and their territories have expanded towards other mountains of western Macedonia since the end of the 1980s. The Vernon (Vitsi) Mountain and Siniatsiko (Askio) Mountain are part of the mountainous range where the bear is present.

The grey wolf (*Canis lupus*) is known to occur throughout western Macedonia, at middle and high altitudes, wherever there is food availability. The total Greek population is estimated at 600 individuals but could be higher. Local populations are difficult to estimate as wolf packs have large ranges which

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¹ International Union for the Conservation of Nature
extend to hundreds of kilometres and may cross the borders of Greece in several areas.

European ground squirrel, or souslik, (*Spermophilus citellus*) are from a conservation point of view, one of the most important species within the Study Area. The species lives in colonies and occurs in short-grass steppes, abandoned cultivations or grasslands, where they build complex underground tunnel systems. This species has been reported at a few sites within the Study Area, including the valley of Axios, Kozani and the fields of Giannitsa.

A total of 69 bird species (most of them water birds) recorded in the Study Area are listed in the Greek Red Data book, IUCN and/or Bird Life International. Among these species, 21 are at least partly resident, 37 are summer visitors and breeders, 7 are winter visitors, while 4 are only passing through the Study Area. The most important species occur in the major wetlands in proximity to the Study Area.

Concerning the hills and mountainous areas, there are breeding raptors such as the Golden Eagle (*Aquila chrysaetos*) and the Lanner Falcon (*Falco biarmicus*), while the forests host Black Storks (*Ciconia nigra*), as well as several species of woodpeckers. Farmland also hosts some important species, including Montague’s Harriers (*Circus pygargus*) and Lesser Kestrels (*Falco naumanni*) which are known, both, to breed in the Olympias – Galatea plateau.

Information on freshwater fish species is scarce and mainly limited to the Aliakmonas water basin, which is known to host thirty eight (38) freshwater fish species of which several may also inhabit saline or brackish habitats (mostly within the delta area and downstream the Polifitos dam).

### 2.5.4 Protected Conservation Areas

The proposed Project route crosses the Axios – Loudias - Aliakmonas Estuaries National Park Natura 2000 site (*GR 1220002; GR1220010*). This area has been recognised as a wetland of major ornithological interest since the beginning of the 1970s when it was declared a Ramsar site. The proposed 2 km Study Area corridor (but not the 38 m wide Project ‘Working Strip’) crosses the northernmost edge of the National Park.
2.5.5 Archaeology and Cultural Heritage

Human occupation has been favoured in Central and Western Macedonia through the centuries, attracted by the abundant resources of the region and intermediate climate between continental Europe and the Mediterranean. Additional attractive factors have included strategic location in one of the Balkan Peninsula’s significant centers of production and population, including Kastoria, Florina, and Kozani basins as well as the plain extending from Thessaloniki to Edessa and Veroia. Due to its central location as southern entryway from Asia to Europe, Macedonia has been subject to constant population movements and thus has a complex cultural history.

Cultural heritage sites identified within the Study Area date from Neolithic to Modern period. Types of sites include: archaeological sites such as settlements, fortified sites, cemeteries, burial mounds and monuments such as churches, monasteries, towers, traditional bridges, and also intangible cultural heritage (ICH), i.e. a site, place or structure with spiritual or emotional importance to local communities that is not always evident from its physical characteristics.

A total of 62 sites along the 2 km wide Study Area corridor were identified by a combination of desk and field study. The most sensitive zone along this route is considered to be the western section of the Project.

2.5.6 Socio-economic Environment

The pipeline route passes through two regions, Central and Western Macedonia, and 11 municipalities (based on Kallikratis reform).

The land use along the route is predominantly agricultural. State owned forest and some grassland make up most of the remaining land. The area crossed by the eastern section of the route is dominated by permanently irrigated agricultural land while agricultural activities become more diverse in the following sections of the route, including scattered permanent crops and cultivation of beans, tomatoes and cucumbers in covered greenhouses. Further to the west, the pipeline route passes into a more mountainous area where the land is predominantly forested, after which it re-enters agricultural areas. The corridor also crosses concession areas for future exploration of lignite. This has been discussed with the owner, the Public Power Corporation (PPC). Towards the border, the route passes mainly through patches of non-
irrigated arable land, shrublands and natural and afforested on the final section to the border.

The more densely populated municipalities are located in the eastern part of the Study Area, in the Region of Central Macedonia, with Pella (98 inhabitants per km²) being the most densely populated followed by Chalkidona and Alexandroupoli (90 inhabitants per km²). Secondary data and interviews show that between the 1960’s and 1970’s population numbers in the municipalities in the Study Area dropped dramatically and many settlements lost more than 20%-30% of their population. Since the 1980’s the population in the area has remained relatively stable and no other dramatic changes have been observed.

The Study Area includes three medium to large population centres: Ptolemaida (28.700 inhabitants), Kastoria and Alexandroupoli (both around 16.000 inhabitants). All three are important to the wider area as they provide large health facilities (hospitals), economic activities and employment opportunities.

The age distribution of the population in the Study Area is fairly even with the largest share of the population between the ages of 20-39 (29%), jointly followed by the 40-59 and over 60’s group (24% each) and finally the under 19’s group (23%). These figures broadly reflect the national distribution. The education level is lower than the national average. 37 to 40% of the population have primary school level education, while those that dropped out of school or are illiterate represents another 12 – 14% of the population. In contrast, only 5% have university education.

Agricultural activities and animal husbandry remain the dominant economic activity in terms of employment within the Study Area. Manufacturing is the second most important economic activity, mainly in the municipalities of Kastoria, Nestorio, Veroia, Skydra and Chalkidona. Until the late 1990’s the fur industry was thriving and employed many people, especially in Kastoria and Nestorio. However, in the past decade the industry has been in decline. The energy sector, including lignite and nickel mining and related industrial activities, employs large numbers of people in Eordaia and a growing number of people in Amyntaio, particularly in the expanding population centres (Ptolemaida and Amyntaio).
2.6 POTENTIAL IMPACTS AND MITIGATION

2.6.1 Introduction

Potential environmental and socio-economic impacts associated with a linear Project of this nature were identified and assessed during the PEIA process. Any potentially major negative impact associated with the construction and operation of the Project has been avoided by means of careful route refinement and design.

Construction impacts of a pipeline and associated facilities are typically temporary in nature and localised. Construction impacts include temporary noise and air emissions from construction machinery, impacts on land use, loss/disturbance of natural habitats (flora and fauna). The magnitude and significance of construction impacts will depend on the local conditions. Typically construction impacts can be managed and mitigated efficiently.

Impacts during operation relate to permanent Project structures such as the compressor station with air and noise emissions. In addition, there is permanent restrictions that will apply to the land use along the pipeline and around the above ground installations.

A summary of the key findings of the preliminary impact assessment process is provided below.

2.6.2 Biodiversity and Nature

There are three major categories of impacts on vegetation and wildlife during pipeline construction:

- Impacts from habitat loss due to elimination of the vegetation along the working strip;
- Disturbance on localised populations of limited dispersal ability; and
- Indirect disturbance to species of nature conservation interest from Project activities.

Some of the preventive/mitigation measures that are envisaged to be applied for the protection of biodiversity and nature include the use of alternative
construction techniques to open cut trenching and backfilling (e.g. Horizontal Directional Drilling), the narrowing of the working strip in ecologically sensitive areas, the restoration at pre-construction conditions as far as possible (e.g. re-vegetation of construction corridor, including trees – with the exception of the 8 metre wide safety zone).

The detailed ESIA will identify adequate mitigation measures to address impacts on biodiversity and nature in a structured way. Next to an overall Environmental and Social Management Plan, specific management and monitoring plans will be developed as appropriate to address restoration of vegetation and landscape, protection of certain flora and fauna species and other issues relating to nature conservation that will require particular mitigation attention; this may include a Biodiversity Action Plan (BAP) as defined by EBRD’s PR6).

Project operation will require that an 8 metre wide permanent corridor is maintained free of deep rooting plants to protect the integrity of the pipeline, i.e. forest cuts that were created during construction can not be fully restored. On the other hand, corridors in forests also provide opportunity to enhance biodiversity. No significant impacts to nature and biodiversity from operation of the compressor stations or the block valve stations are anticipated. Air and noise emissions will be within applicable limits and will not adversely impact vegetation of wildlife.

2.6.3 Water Environment

Potential impacts to water environment that were identified during the PEIA are given below:

- Impacts to aquatic habitats, water quality & river morphology from river crossings of the right of way and access roads
- Accidental pollution by oil and lubricants or fuels from machinery on working strip, yards, camps and access roads
- Accidental pollution by waste water and solid wastes (from camps, working strip) not properly captured or managed

Good practice measures in managing construction site equipment, liquid discharges or solid waste will ensure that the associated impacts are minimised. Other measures will include provisions that topsoil and other debris
is protected against heavy rainfall and entrainment, hydrotesting water will be reused in subsequent sections of the pipeline, water discharge to local receptors will not alter their hydrological patterns, and that appropriate emergency response measures to address accidental spills or other incidents at construction sites will be put in place.

No significant impacts to surface water during Project operation are anticipated. Waste water discharges from the compressor stations will be treated before disposal and are not expected to impact adversely on aquatic environments.

### 2.6.4 Subsurface, Soils and Contaminated Land

Project impact to the soil and subsoil during pipeline construction is mainly related to the presence and movement of heavy machinery which may result in:

- Physical damage through soil compaction and accidental contamination,
- The clearance of the working strip, logistic sites and access roads, access roads which may affect top soil functions for habitats and agriculture, and
- The excavation works during construction including off-site quarrying where required (compressor station and block valve stations).

Detailed information on soil types along the proposed pipeline route will be collected during the detailed ESIA stage including taking typical soil profiles in the field. Also information regarding existing soil contamination will be collected in order to identify relevant measures during construction to prevent spreading of pollution.

A detailed construction site management plan will be implemented. This will include inter alia provisions for erosion protection, mitigation of soil compaction and prevention of soil pollution including cleanup of any accidental spills from construction machinery.

In rocky sections with shallow soil, heavy duty trenching works including blasting may be required. According to present planning detail, no significant rock or earth movements (such as crest cuttings) or deposition of significant amounts of overburden will be necessary, which would require dedicated
disposal sites for surplus material. It is anticipated that most of the excavated materials can be backfilled or integrated in site reinstatement works. The ESIA will further investigate this based on more detailed planning information as becomes available.

No significant impacts to soil and subsoil are envisaged during Project operation. In case that any external pipeline maintenance becomes necessary, i.e. digging up of the pipeline for repair (which would be an exceptional case), impacts and mitigation at the particular location would be are similar to those of the construction stage.

### 2.6.5 Air Quality

During Project construction, the impacts to ambient air are related to the following:

- Temporary dust emissions from the construction strip; and
- Temporary emissions of exhausts from machinery and vehicles.

Mitigation measures to control dust emissions will include good construction site management practices. The exhausts from construction vehicles machinery (NO\textsubscript{x}, CO, SO\textsubscript{2}, etc.) will be limited and localised and of temporary nature and not exceed levels of country side traffic.

During operation, impact in air quality will arise from the operation of the compressor station, which burns gas to produce the energy required to increase the gas pressure in the pipeline.

In accordance with TAP AG’s philosophy to undertake the project in line with international best practice standards and the relevant EBRD Performance Requirement (PR3), the compressor stations design will adopt the EU’s Best Available Techniques (BAT) for the abatement of air pollutants; plant maintainance will be undertaken accordingly.

During regular operation the only relevant emission sources are the exhaust gases leaving the ducts of the gas turbines and nitrogen-oxides (NO\textsubscript{x}) the only compounds of relevance. Dispersion modelling undertaken to identify the magnitude of the potential air quality impact in the airshed of the compressor stations has shown that both short term and long term concentration levels of


NOx are well within the applicable limit values, which are established to protect human health and preservation of habitats.

The project operation will include air emissions and ambient air quality monitoring.

### 2.6.6 Noise and Vibration

Noise during Project construction is mainly related to the operation of vehicles and machinery and is typical level of noise encountered in construction sites. Particularly noisy activities are temporary in nature and very few along the pipeline route. The location and requirement for any of these activities will be confirmed and assessed in the ESIA.

Besides complying with the prevailing legislative framework, in construction areas neighbouring settlements appropriate measures will be included in the environmental and social management plan, such as using specific mitigation on noisy equipment (acoustic shielding); locating noisy equipment (e.g. generators, compressors) away from noise sensitive receptors; monitoring of main emission sources (generators, compressors), apply low vibration piling techniques etc. In general, noisy activities during construction will be limited to the daytime (night work may only exceptionally apply).

Noise emissions during Project operation are only related to the operation of the compressor station. The compressor station will fully comply with the limits imposed by legislation for environmental noise at the borders of the facility. Noise emissions modelling during ESIA will help to ensure that the associated impacts are identified and mitigated.

### 2.6.7 Cultural Heritage

During the preparation of the PEIA study, thorough research based on available data and information of potential cultural or archaeological places of interest been undertaken. The incorporation of information received by the Large Projects Department (LPD) of the Ministry of Culture to Project design, expected to be completed at ESIA stage, will ensure that any significant impact to cultural heritage will be avoided.
Further mitigation measures to be developed will be in line with pertinent Greek regulations and the requirements of the EBRD PR8 and *inter alia* include the following:

- Detailed reconnaissance survey of known monuments, Intangible Cultural Heritage and archaeological sites, in cooperation of the local Ephorates of Antiquities.
- Removal of resources by rescue excavations and associated studies.
- Development of a Cultural Heritage Management Plan.

No impacts to cultural heritage are envisaged during Project operation.

### 2.6.8 Land Use

During construction, temporary land use changes will result, associated with the working strip for the pipeline and associated facilities such as stock yards, construction worker camps and access roads.

The working strip for the pipeline will in general be 38 m, with the option to reduce this to 28 m where required by socio-economic, environmental conditions or technical restrictions apply.

Following construction, the land affected by construction will be reinstated and returned to its original owner and use, where possible.

However, users and owners of land will be affected by permanent restrictions to assure the integrity of the pipeline and provide for safety distances to other uses, according to the TAP standards:

- A permanent pipeline protection strip (PPS) with a width of 8 m will be established (i.e. 4 meters either side of the centreline). The cultivation of annual field crops will be allowed (max ploughing depth of 30 cm), but the protection strip has to be kept free from any cultivation of plants with deep routing system such as olive and fruit trees, or any other bushes or trees.

- The construction of new structures will be restricted in a safety zone of maximum 60 m (*i.e* 30 metres to both sides of the centre line) and the establishment of cluster of houses and/or industrial infrastructure in a corridor of maximum 200 m (*i.e* 100 metres to both sides of the centre line). The preferred route was selected considering this constraint and
distance to settlements allows sufficient space also for future developments of communities neighbouring the pipeline.

- Additionally, land use restrictions in the near surrounding of the compressor station may apply triggered by risk protection requirements. The foreseen extend of the fenced compressor station premises of approximately 41 hectares which will be purchased by TAP AG, already includes a safety buffer. Results of further risk studies will inform if additional safety distances and restrictions on land use around the compressor station will be required.

Several measures will be implemented to ensure that no impact will arise from the operation of the pipeline to land uses, property or people. The Livelihood Restoration Action Plan will consider impacts to land during operation and decommissioning and provide for compensation to land owners/users. The *livelihood restoration plan* will assure that these restrictions do not result in the impoverishment of the people owning and/or using these lands. Any compensation will be compliant with Grege regulatory requirements and in line with the relevant EBRD Performance Requirement (PS5).

A *Land Restoration Plan* will be implemented to restore any project affected land for productive use after decommissioning of the project.

During operation, TAP AG will maintain the right to access the pipeline for inspections and maintenance but ownership of the land will remain with the original owner.

2.6.9 Infrastructure

Given the length of the pipeline, several crossings with existing infrastructure networks will be necessary including roads, energy lines, telecommunication cables, irrigation channels, water pipelines, sewerage network etc. The Project will establish measures to cross these networks safely and with minimal disruption to the utilities they supply to people in the area.

No impacts to existing to infrastructure are anticipated in the Project operation. Any establishment of new infrastructure will need to comply with the restrictions and safety norms including setback distances to protect the integrity of the pipeline.
2.6.10 Economy and Employment

The main benefit of TAP to Greece is the taxes to be paid every year for the transit of gas. For the full capacity case 20 BCM this is preliminary estimated to amount to 60 million Euro per year and over 3 billion Euros over the lifetime of the project.

Positive economic impacts during construction may include the generation of direct and indirect employment for people living in the Study Area, induced economic impacts and wider economic impacts through improvements to infrastructure (e.g. improvement of roads in the Study Area). TAP AG will work to maximise employment and procurement benefits for the local community by promoting the use of the local workforce in the Project in line with TAP AG’s Local Content Strategy and CSR Policy.

Economic benefits to the local economy may arise from limited direct/indirect job creation during operation of the pipeline. Individuals or companies may benefit from employments and procurement opportunities associated with the compressor station, maintenance etc. Wherever this is possible, TAP AG will procure goods from local suppliers through sub-contracts to local firms (subject to availability, quality and cost) and purchasing of goods from local retailers.

2.6.11 Community Health, Safety and Security

Potential impacts on community health and safety during construction include a temporary increase in road traffic including heavy good vehicles (e.g line pipe trucks) resulting in an increased risk of road traffic accidents, a decrease or perceived decrease in environmental quality including increased noise and decreased air quality due to dust and traffic exhausts.

The presence of an outside workforce, preliminary estimated to be up to one thousand fivehundred people at peak time during construction, could have a number of impacts on local communities in the immediate area. Some of these potential impacts include increased consumption on local goods and services; impacts on local customs, norms and social institutions with implications for the cohesion of the local community, e.g in case of workers misbehaving, abuse of alcohols or drugs. TAP AG will address these issues and minimize potentially negative impacts associated with an outside workforce by requiring contractors to implement a strict “Code of Conduct”, worker management
policies and prevention measures covering public health and safety issues along with respect for the environment and respect for local people. Attention will also be given to minimise phenomena that are known to occur from the temporary presence of large workforce, such as the potential risk of sexual transmitted diseases.

Potential impacts and risks for community health and safety will be addressed through the implementation of appropriate mitigation in consultation with the relevant authorities and local administrations based on specific traffic risk assessments, and health impact assessments which are integrated into the ESIA.

For operation of the pipeline system, emergency response plans will be developed. Emergency response capacities and infrastructures (fire brigades, hospital equipment etc.) may also be enhanced as needed with the support of TAP AG based on this plans. All plans will be developed in compliance with Greek regulatory requirements, the relevant EU framework, and the relevant Performance Requirement of the EBRD (PR4).

2.6.12 Labour and Working Conditions

During the construction works activities there is an increased risk of injuries to the workforce at sites with major excavations, tunnelling and working in the vicinity of active roads. TAP AG will develop an HSE Management System for the Project in accordance with international good practice which will identify risks to worker health and safety. Additionally, good site management practice will be implemented to reduce health and safety risks.

In order to ensure that the workforce is treated fairly, TAP AG will abide by all relevant legislation related to labour and working conditions and implement appropriate standards and policies related to workers conditions including hiring policies, grievance mechanisms for workers. These requirements will be included in all contractor agreements and will refer to Greek regulatory and EU framework and the relevant Performance Requirement of the EBRD (PR2) and reflect the relevant sections of TAP’s CSR policy that contain *inter alia* the commitment to assure compliance with core labour standards of the International Labour Organisation (ILO), the voluntary principles of security and human rights. TAP AG will assure compliance of labour related topics by the contractors through monitoring.
2.7 **IMPACTS FROM DECOMMISSIONING**

Any decommissioning activities will be carried out according to the *state-of-the-art* and best practice available at that time and will avoid or minimise any impacts, e.g. from dismantling of installations.

2.8 **CUMULATIVE, COMBINED AND SECONDARY IMPACTS**

Cumulative impacts are effects where the Project is taking place at the same time as other developments and they have cumulative effects on the same receptors and resources. Combined impacts are effects that arise from the combination of different effects on specific resource or receptor e.g. noise, dust and traffic congestion all affecting the same group of residents. Secondary impacts are effects that occur as a result of primary effects, for example, impacts on ecosystems can be caused by changes in air quality resulting from Project emissions.

Other existing developments, which may have cumulative impacts within the area of influence for this Project, will be considered and their environmental and social impacts taken into account in defining the baseline for the ESIA.

Two particular planned projects of note include:

- Public Power Corporation extractive mining activities; and
- Public Power Corporation, the future works for the transfer of PPC substation in the area of Kardhia which will require relocation of many high voltage lines.

2.9 **ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN**

An Environmental and Social Management and Monitoring Plan (ESMMP) will be prepared for the Project, as part of the detailed ESIA.

The main objectives of the ESMMP are to:

- Provide a framework for continuing compliance with relevant Greek legislation and relevant international standards;
- Ensure that best industry practice is adopted throughout the construction, commissioning, operation and decommissioning of the pipeline;
• Provide a mechanism for ensuring that measures to mitigate potentially adverse environmental and social impacts are implemented;
• Provide a framework for mitigating impacts that may be unforeseen or unidentified until the Project is underway;
• Provide assurance to third parties that their requirements with respect to environmental and social performance will be met; and
• Provide a framework for compliance auditing and inspection to enable TAP AG to be assured that its aims with respect to environmental performance are being met.

The ESMMP will be a document that continuously evolves throughout the life of the Project. It will be developed as further consultation and route investigations take place, and detailed design and working method statements are prepared.

2.10  STAKEHOLDER ENGAGEMENT

TAP AG has developed a Stakeholder Engagement Plans (SEP) for the Project in line with Greek Legislation and the European Bank for Reconstruction and Development (EBRD) Performance Requirements on Stakeholder Engagement in the course of Environmental and Social Impact Assessment (PR10).

The main goals of the SEP are to ensure that:
• Adequate and timely information is provided to Project-affected people and other stakeholders;
• Stakeholders are given sufficient opportunity to voice their opinions and concerns; and
• Stakeholder feedback influences Project decisions.

The SEP is a ‘living’ document, which will be regularly updated throughout the Project. Engagement activities undertaken during the initial phases of the Project are being used to define engagement going forward.
3 PROJECT DEFINITION

3.1 INTRODUCTION

The Greek section of the TAP, as described in this PEIA document, is located in northern Greece, with the pipeline route starting at the existing DESFA compressor station at Nea Messimvria, near Anchialos, in Central Macedonia and continuing through West Macedonia to the Albanian border. It is further envisaged that the TAP Project will be expanded to the east to include a section from Nea Messimvria to Komotini which will mainly follow existing pipeline routes. Additional information that will be required to integrate this new section into the TAP Project will be submitted to the authorities at a later date with a view to providing a full ESIA report that includes the complete route: Komotini to the Albanian border.

During the route refinement process the pipeline route and the siting of supporting facilities (see Map 1 – Annex I). An overview of the most significant options considered is given in Section 3.3, while a more detailed assessment of Project Alternatives is provided in Section 6.

3.2 DEFINED PROJECT

The preferred Project pipeline route (Base Case), as presented in this PEIA, starts at Nea Messimvria and follows a western direction through the Municipalities of Chalkidona, Pella, Skydra and Edessa. It then turns to the south through the Municipality of Eordea and continues west through the Municipalities of Aminteo, Kastoria, Orestida and Nestorio (see Figure 3-1 and Map 1 – Annex I). It crosses into Albania near the Iropigli village. The total length of this section of the TAP in Greece is approximately 181 km, with 95 km of pipeline in Central Macedonia and 86 km in West Macedonia.

The pipeline system facilities includes approximately 8 block valve stations along the 181 km route. Depending on further technical system studies,

(1) The route refinement process preceded the PEIA with the aim to narrow down the initial 50 km wide project corridor between Nea Messimvria and the Albanian border, to a 2 km wide corridor that would form the basis for the PEIA and define a number of viable alternatives. The alternatives assessment study was conducted between Autumn 2010 and Summer 2011.
compressor station CS02 will be either located in Albania near the Albania/Greek border or as an option in Greece near the border to the west of Kastoria. The exact location of CS02 will be based on detailed gas flow and pressure drop calculations along the pipeline system. In case that CS02 would be installed in Greece, the preferred site is located approximately 2 km to the south-west of Mesopotamia village (Site Alternative C).

3.3 Project Alternatives

3.3.1 Pipeline Route

The southern Alternative S₀ pipeline route starts at Nea Messimvria and follows the same route as the Base Case for approximately 19 km. It then heads towards the southwest, predominantly following the Egnatia Highway corridor, as shown in Figure 3-1. It crosses the Municipalities of Chalkidona, Pella, Alexandria, Veroia, Kozani and Voio. South of Siatista, the route turns towards the northwest to cross the Municipalities of Orestida, Kastoria and Nestorio prior to reaching the Albanian border.

Figure 3-1 Routing Alternatives of the TAP in Greece (Base Case and Alternative S₀)
3.3.2 Compressor Station Location

Compressor Station 2 (CS02) will be needed for the full 20 BCM/y pipeline system. In the initial 10 BCM/y case, only a metering station will be established near the border to Albania and this would then be expanded to the CS02 for the 20 BCM/y case. For CS02, two locations were identified for the Base Case route (shown in Figure 3-2)\(^1\). CS02 Alternative D is located approximately 1.5 km east of the Albanian border in the hill lands, approx 3 km to the southwest of Ieropigi village. The location takes into account the extension of the Larco nickel mine which is located to the north-east. CS02 Alternative C, is located approximately 2 km to the West of Mesopotamia town in agricultural plains (pipeline route distance approx. 10 km from the border) The preferred site is Alternative C, since the terrain is flat, as opposed to the hill lands near the border. Alternative D location has further constraints: It that is surrounded by black pine forest, which would be partially needed to be cut, and the remote forested border hilllands are bear habitats.

The pipeline system will also require the installation of 8 blockvalve stations approximately every 30 km and associated facilities during the construction phase (access roads, worker camps, pipe yards).

\(^1\) Also the the southern Sc route alternative a compressor station site (CS2 Alternative site A (CS2a) had been identified in approximately 1.5 km distance to the border on hilly agricultural terrain. Since the preferred route is the northern Base Case route, i.e the Base Case route, the CS2a site is not further discussed.
Figure 3-2 Indicative Locations of Compressor Station 2 (preferred CS02C and Alternative CS02D)
3.4 PROJECT’S LEGAL FRAMEWORK FOR ENVIRONMENTAL IMPACT ASSESSMENT

3.4.1 Greek and European Legal Framework

The TAP Project in Greece is being developed in compliance with Greek laws and regulations as well as the EIA Directive of the EU and the EBRD Performance Requirements. This section provides a brief description of the Environmental Impact Assessment legislation in Greece:

- **Law No. 1650/1986** – is the main legal provision for the Protection of the environment in Greece. In particular the following articles are relevant to the EIA process:
  - **Art. 3** – introduces the classification of projects and activities (Cat.A, B and C);
  - **Art. 4** – defines the approval of environmental terms, concerning the realization of any project or activity referred in the article 3;
  - **Art. 5** – defines the contents and the disclosure of the EIA.

- **Joint Ministerial Decision 69269/5387/90** – This decision was enacted in order to activate and implement the above mentioned articles 3, 4 and 5 of Law 1650/1986 and simultaneously to enforce **EC Directives 84/360 (Directive of 28.6.1984 on the combating of air pollution from industrial plants)** and **85/337 (Directive of 27.6.1985 on the assessment of the environmental impacts of certain public projects and private activities)**. This JMD describes the specific content of the environmental impact assessment studies, according to the category of the activity to be implemented. The JMD refers in particular to the activities of the A and B categories and to the description and minimisation of the environmental impacts related to these activities. The chapters that the environmental impact assessment study should contain are also set and explained. Also, the required papers, maps and documentations are described;

- **Law No. 3010/2002** – This Law sets the new legal provisions for environmental permitting procedures amending the framework Law on Environment (Law 1650/1986) in order to implement the **Directives 97/11/EC (EIA)** and **96/61/EC (IPPC)** in the Greek Legislation framework. These amendments refer in particular to the categorization of activities and works according to their environmental impacts, to the content and
publicity of the environmental impact studies and to the conditions included in the environmental permits;

- **Joint Ministerial Decision 15393/2332/2002** – The JMD categorises all the works and activities in more specific groups as foreseen in the Law 3010/2002. All the activities and works are categorised in 10 groups;

- **Joint Ministerial Decision 11014/703/Φ104/2003** – This JMD sets environmental permitting procedures. More specifically, this JMD defines:
  
  o the specific EIA process until the acquisition of the permit;

  o the competent authorities;

  o the general content of the EIA studies for all installations (the specific chapters are described in the JMD 69269/5387/90);

- **Joint Ministerial Decision 37111/2021/2003** – The JMD sets the procedure of the public information and the participation in the framework of the environmental permitting system.

### Table 3-1  
**Greek Legal Framework on Environmental Impact Assessment**

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Year</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law</td>
<td>1650</td>
<td>1986</td>
<td>Environmental Protection</td>
</tr>
<tr>
<td>JMD</td>
<td>69269/5387</td>
<td>1990</td>
<td>Project Classification and EIS Content</td>
</tr>
<tr>
<td>Law</td>
<td>3010</td>
<td>2002</td>
<td>Project Classification</td>
</tr>
<tr>
<td>JMD</td>
<td>15393/2332</td>
<td>2002</td>
<td>Project Classification</td>
</tr>
<tr>
<td>JMD</td>
<td>11014/703</td>
<td>2003</td>
<td>PEIS and EIS Process</td>
</tr>
<tr>
<td>JMD</td>
<td>37111/2021</td>
<td>2003</td>
<td>Public Participation</td>
</tr>
</tbody>
</table>

#### 3.4.2 Preliminary EIA (PEIA)

The procedure for the PEIA in Greece, for projects like the TAP, can be summarised in the following phases:
• **Preliminary Environmental Impact Assessment**: the applicant shall provide a preliminary EIA (PEIA) of the project to the MEECC (this report);

• **Check for Completeness**: MEECC will check the PEIA for completeness and may request additional information, prior to distributing for consultation;

• **Statutory Consultation**: opinion/response from the Central Authorities or other co-competent Ministries or organizations (e.g. Physical Planning Directorate);

• **PEIA Decision**: MEECC will consider the results of the consultation and will issue its decision

• **Publication of Decision**: publication of the decision of MEECC through the relative Regional Council (through which the public is informed).

### 3.4.3 EIA

The procedure for the Environmental Impact Assessment in Greece, for projects like the TAP, can be summarised in the following phases:

• **Environmental Impact Assessment**: the applicant shall provide an EIA of the project to the *Ministry of Environment, Energy and Climate Change* (MEECC);

• **Check for Completeness**: MEECC will check the EIA for completeness and may request additional information, prior to distributing for consultation;

• **Statutory Consultation**: opinion/response from the Central Authorities or other co-competent Ministries or organizations (e.g. Physical Planning Directorate);

• **Public Consultation**: the project is presented to the Regional Council during an open hearing where people can express their views

• **Decision on Approval of Environmental Conditions**: MEECC will consider the results of the consultation (statutory and public) and will issue its decision, co-signed by other competent Ministries

• **Publication of Decision**: publication of the decision through the relative Regional Council.
4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 INTRODUCTION

This Section describes the environmental (physical and biological), cultural heritage and socioeconomic resources of the Project route and its surrounding environment. The following elements have been considered:

- flora and vegetation;
- fauna and habitats;
- landscape and geomorphology;
- geology;
- climate and meteorological conditions;
- archaeology and cultural heritage; and
- social- and socioeconomic environment.

The environmental and cultural heritage baseline presented in the following Section has focussed on a Study Area consisting of a 2 km wide corridor (1 km either side of the proposed centre line of the pipeline) along the entire length of the Base Case route (refer to Figure 4-1).

The socioeconomic baseline characterisation presented has also focussed on this Study Area along the Base Case route. However, some of the baseline data discussed also covers a wider area consisting of the 11 municipalities crossed by the proposed pipeline route. A broader Study Area that includes the area of Western and Central Macedonia has been considered for indicators such as health services and infrastructure.
4.2 Methodology

Information presented in this Section has been drawn from a desk top study of existing published and unpublished information and field surveys. Field survey data was collected during the alternatives assessment phase (see Section 6) in a 2 km corridor, while the desk top data provide information for a wider area.

4.2.1 Desktop Study

The desktop study of the Project route corridor was undertaken between September 2010 and September 2011 with the aim to gather a range of existing baseline information to identify potential environmental, cultural heritage and socioeconomic constraints within the Study Area. The literature that was used in the baseline chapter is cited in the References Chapter 11. The desk-top baseline data was also utilised to define the most appropriate scope of work for the field surveys.
Environment

The information gathered during the desktop study included the following specific areas of interest:

- Ramsar Sites from Wetlands International.
- Wildlife refuges, Designated Landscape Areas, Natural Monuments and Landmarks and National Woodland Parks from the Greek Ministry of Environment, Energy and Climate Change.
- Important Bird Areas from Hellenic Ornithological Society (Birdlife International partner).
- National Parks, Natura 2000 sites and 92/43 EEC habitats from the Greek Ministry of Environment, Energy and Climate Change.
- River network from the Greek Ministry of Environment, Energy and Climate Change.
- Forestry maps from the Greek Ministry of Agricultural Policy and Food.
- CORINE Land Cover Classifications from the CORINE database.
- Serpentine soils (areas of rich floral biodiversity).
- Bear (Ursus arctos) range within Western and Central Macedonia from the NGO Arcturos.
- Key fauna and flora species from technical reports and scientific papers.

Cultural Heritage

During the desk study the archaeologists collected and analysed data from various sources, including databases, archaeological and historical literature, historic maps, and topographic maps. Known cultural heritage sites were identified in the Study Area including archaeological sites, monuments and intangible cultural heritage sites (ICH). The referenced sources were found on the internet, including the official site of the Greek Ministry of Culture and Tourism, and in institutions such as libraries, museums, universities and research institutes. The archaeologists also contacted the relevant Ephorates of Antiquities responsible for the Study Area.
Meetings were held with the following authorities:

- 30th Ephorate of Prehistoric and Classical Antiquities for the District Unit of Kozani;
- 16th Ephorate of Byzantine Antiquities for the District Unit of Kastoria and Florina; and
- 17th Ephorate of Prehistoric and Classical Antiquities, responsible for the District Units of Florina and Imathia.

The quality of site data obtained from the Ephorates and other sources varies greatly. Data for some of the sites are very good, being based on detailed excavations that were followed up by analysis and publication. Data from other sites are incomplete and not fully verified because the sites may not have been investigated yet or, if investigated, have not yet been published.

Further to this, the Large Projects Department (LPD) has been consulted and an official reply from all the relevant Ephorates of Antiquites has been received. The official reply includes all the designated and known sites to the authorities as there is always the risk to find archaeological findings during the excavation of the construction zone.

**Socioeconomic**

The focus of the socioeconomics desktop baseline study was to identify relevant social aspects of the Study Area through secondary data gathering which included published and unpublished data from government sources such as:

- Regional authorities;
- Municipalities/communes at a local level; and
- Institutions and ministries.

Secondary socioeconomic data in Greece are publicly available from the Hellenic Statistical Authority at the regional, municipal, and settlement level dating from 2001 (the date of the last Census in Greece). Information collected during the desk top study was assessed with regard to completeness and reliability and, where necessary, attempts were made to complement and verify this data during the field work.
4.2.2 Field Survey

The environmental, socioeconomic and cultural heritage field surveys were conducted between November 2010 and February 2011 during the alternatives assessment phase and covered both proposed alternative corridors (see Section 6). The surveys covered the entire length of the alternatives and provided a good understanding of the environmental, socioeconomic and cultural heritage characteristics of the Study Area. Additional surveys were conducted to assess the potential constraints along minor re-routings were conducted in May and September 2011. The surveys performed to date are however not to be considered comprehensive and exhaustive. Detailed field surveys for the preferred route will be conducted for the ESIA.

Biological and Physical Environment

The environmental survey focussed on flora, vegetation, fauna, habitats and landscape. The survey locations were selected with the main objective of visiting sample locations of all the main habitat types. In addition, efforts were concentrated in those areas with the highest ecological interest (e.g. mountain areas with natural and semi natural environments).

All information on protected areas and the Greek legal system regarding nature protection is based on documents and legal papers published before the end of March 2011. Extensive species lists of flora and fauna have been drawn up, mostly according to literature records, and ground truthed to the extent possible during the field surveys - these lists are presented in Annex II.

The timing of the surveys (November and February) resulted in a number of limitations due to the ecology of many flora and fauna species:

- Flora, Vegetation and Landscape: from a phenological point of view, autumn and winter is the time of the year when all therophytes (plants that survive the unfavourable season only in the form of seeds) are absent, deciduous species have shed their leaves and only evergreen taxa can be readily identified unless the fruit/seed is also found.

- Fauna: winter is the period of hibernation for several vertebrate species whereas species that are only summer visitors were not present at the time of the surveys.
As such only taxa whose distribution is relatively well-known across continental Greece was ground truthed. Emphasis was given to taxa that are under protection or are considered as threatened and have been recently reviewed with regards to their status in Greece, the Mediterranean or Europe. As a result, species groups such as Orthoptera whose biogeography is well known in Greece but their conservation status is poorly explored were not assessed.

No field baseline data was gathered on physical components such as background noise levels, air quality, water quality (surface and groundwater), sediments and soils within the Study Area. This will be performed during the ESIA stage to provide a baseline against which impacts will be measured.

Cultural Heritage

The field study focused on visiting the previously-reported archaeological sites within and adjacent to the Study Area. Areas believed to have a high potential for unknown archaeological sites were also visited, as were lower potential areas. During the fieldwork, the cultural heritage team was able to ground truth approximately half of the previously reported sites. The official reply form the LPD was received after completion of the field surveys. The cultural heritage sites, which were recorded in the field but had not been identified in the bibliography, comprised approximately 30% of the known sites.

Intangible cultural heritage (ICH) refers to customs, traditions and beliefs that make a people or a region distinctive and socially cohesive. ¹This type of heritage is protected by international treaty and agreements to which Greece is a party and is also referenced by Greek national law (L.3028/02).

(1) ¹ ICH is often central to the ethnic and cultural identity of a people, with local, unwritten languages and unrecorded customs being prime examples. ICH resides in living communities and has a significance that is based in the contemporary world. It clearly includes historic monuments, archaeological sites and historic landscapes. ICH can also include special natural features, such as flora, fauna and particular ecological zones. For these reasons a competent treatment of ICH requires the methods and expertise of social, environmental and cultural heritage specialists.
The categories of ICH are addressed by the three disciplines as follows:

- Cultural heritage studies include relevant immovable historic features such as archaeological sites, historic monuments, cultural landscapes, geological features and historic districts;
- Social studies include relevant cultural aspects such as language, music, other folk customs and the portable materials associated with them; and
- Environmental studies include relevant flora, fauna and their habitats.

ICH elements addressed included currently used traditional places of worship, accident shrines along the Study Area roadways, and the locations of important, relatively recent historical events of significance to local communities, such as civil war conflicts and other emotionally charged events.¹

**Socioeconomic**

The socioeconomic field surveys focused on the land use in the 2 km corridor Study Area. The team also surveyed adjacent areas to better understand the use of the corridors by neighbouring communities. This field work consisted of the following:

- Meetings were held with officials at the municipality level were used to verify secondary data already collected and to understand whether any significant changes in data or development planning were anticipated following the administrative changes in January 2011.
- At the settlement level, a detailed questionnaire covering qualitative and quantitative data for a sample of settlements was used to verify and supplement available secondary data. Questionnaires covered topic areas including demographics, economy, income, infrastructure and resource use. These data will be collected for all settlements within the 2 km corridor during the ESIA phase.

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¹ These and other types of sites that support intangible social practices, beliefs and traditions are material and immovable. Sites of this nature lend themselves to inclusion together with archaeological sites and historical structures and are therefore included in the cultural heritage inventory.
4.3 MAPPING AND INDICATORS

4.3.1 GIS Setup

A Geographical Information System (ArcGIS) platform has been prepared for the Project, allowing an integrated analysis of all the collected information. The GIS compiles the existing territorial information along the proposed pipeline route 2 km wide study corridor (a buffer of 1 km either side of the proposed alignments) and for the planned logistic components of the pipeline (e.g. access roads, camps, yards). The territorial information on the GIS platform has been obtained from a number of sources which include official and unofficial data, desktop and field survey data.

All points of interest recorded were marked as waypoints using GPS devices and relevant photographs and notes were made. In order to provide an illustration of the area crossed by the proposed route, representative photographs of the area are presented in Annex VII.

4.3.2 Maps of the Wider Area

The Overview Map Greece (Map 1 in Annex I) shows the Greek section of the TAP Project, comprising the onshore pipeline and the alternative routes from Nea Messimvria to the Albanian borders near Ieropigi.

4.3.3 Maps of the Area of Interest

The GIS was used to produce a series of maps showing current land use, populations and livelihoods, protected areas which are used in the baseline description and alternative appraisal. Protected areas and Land use Maps are provided in Maps 2 and 3 (Annex I) at 1:50,000 scale.

The Forestry Maps have provided the basis for the habitat analysis: the information has been reclassified to allow for simplicity in use and then ground truthed during fieldwork. Forestry and Vegetation Maps are provided in scale 1:200,000 (Map 4, Annex I).

The cultural heritage sites that were identified by a combination of desk and field study are illustrated in the Maps of Cultural Heritage (Map 5, Annex I). Moreover, some sites locations were provided by the LPD.
The geological formations of the proposed and alternative routes are presented in the Geological Map, scale 1:50,000 (Map 6, Annex I).

### 4.3.4 Indicators

A set of indicators have been identified and adopted to highlight the key environmental, socioeconomic and cultural heritage features of the Project. The indicators were calculated using the Project’s GIS platform and are based on the baseline information gathered through desk top study as well as the field survey data gathered during the alternatives assessment phase.

Due to the scale of some of the baseline information (e.g. CORINE Landuse) and the preliminary nature of the surveys performed during the alternatives assessment phase, the values reported for the indicators are to be considered indicative and will be refined further in the detailed assessment of the ESIA.

Most of the indicators were calculated for the pipeline protection strip (PPS) (8 m wide, i.e 4 metres either side of the proposed centreline) and the construction corridor\(^1\) which is regular 38 metres wide in order to provide an indication of the baseline characteristics of the areas directly affected by the pipeline construction and operation. Indicators for the 2 km wide Study Area corridor have also been adopted for components which may be indirectly affected by the Project.

The list of indicators with a brief description is presented in Tables 4.1 to 4.3.

<table>
<thead>
<tr>
<th>Table 4-1 Environmental Impact Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact Indicator</strong></td>
</tr>
<tr>
<td>Total length of the Route</td>
</tr>
<tr>
<td>Total length and surface clearance within Protected Areas (excluding Natura 2000 sites)</td>
</tr>
<tr>
<td>Length within Important Bird Areas (IBA)</td>
</tr>
<tr>
<td>Total length and surface clearance within Natura 2000 Network</td>
</tr>
</tbody>
</table>

(3) \(^1\) also commonly referred to as “Working Strip”
<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area of non-urbanised and non-agricultural land crossed</td>
<td>Total clearance area along the working strip classified neither urban nor agricultural by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Total area of non-urbanised and non-agricultural land crossed within PPS</td>
<td>Total clearance area along the PPS in areas classified neither urban nor agricultural by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Total forest clearance</td>
<td>Total clearance area along the working strip classified as forests by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Total forest clearance within the PPS</td>
<td>Total clearance area along the PPS in areas classified as forests by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Total broadleaved forest dominated by <em>Fagus, Quercus</em> and <em>Castanea</em> species to be cleared</td>
<td>Total clearance area along the working strip within areas classified as broadleaved forest by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Total broadleaved forest dominated by <em>Fagus, Quercus</em> and <em>Castanea</em> species to be cleared within the PPS</td>
<td>Total surface to be cleared within the PPS classified as broadleaved forest by the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Beech dominated forests (<em>Fagus sylvatica</em>) clearance</td>
<td><em>Fagus sylvatica</em> dominated areas, according to the official Forestry Maps classification, to be cleared within the working strip</td>
<td>ha</td>
</tr>
<tr>
<td>Beech dominated forests (<em>Fagus sylvatica</em>) to be cleared within the PPS</td>
<td><em>Fagus sylvatica</em> dominated areas, according to the official Forestry Maps classification, to be cleared within the PPS.</td>
<td>ha</td>
</tr>
<tr>
<td>Oak dominated forests (<em>Quercus</em> spp.) clearance</td>
<td><em>Quercus</em> spp. dominated areas, according to the official Forestry Maps classification, to be cleared within the working strip</td>
<td>ha</td>
</tr>
<tr>
<td>Oak dominated forests (<em>Quercus</em> spp.) to be cleared within the PPS</td>
<td><em>Quercus</em> spp. dominated areas, according to the official Forestry Maps classification, to be cleared within the PPS</td>
<td>ha</td>
</tr>
<tr>
<td>Chestnut dominated forests (<em>Castanea sativa</em>) clearance</td>
<td><em>Castanea sativa</em> dominated areas, according to the official Forestry Maps classification, to be cleared within the working strip</td>
<td>ha</td>
</tr>
<tr>
<td>Chestnut dominated forests (<em>Castanea sativa</em>) to be cleared within the PPS</td>
<td><em>Castanea sativa</em> dominated areas, according to the official Forestry Maps classification, to be cleared within the PPS</td>
<td>ha</td>
</tr>
<tr>
<td>Area of coniferous forests $^1$ to be cleared</td>
<td>Total area to be cleared within the working strip supporting coniferous forests (mainly <em>Pinus</em> sp.), according to the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td>Impact Indicator</td>
<td>Definition</td>
<td>Units</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Area of coniferous forests to be cleared within the PPS</strong></td>
<td>Total area to be cleared within the PPS supporting coniferous forests (mainly <em>Pinus</em> sp.), according to the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Area of montane and subalpine grasslands, meadows and pastures to be cleared</strong></td>
<td>Total area of grasslands and montane meadows according to the official Forestry Maps classification to be cleared within the working strip at an altitude &gt; 800 m a.s.l.</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Total area of agricultural lands and plantations to be cleared</strong></td>
<td>Total area to be cleared within the working strip in areas classified as agricultural land (including permanent and yearly crops) in the official Forestry Maps classification</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Area covered by bPPSn bear range crossed</strong></td>
<td>Total area within the 2 km corridor suitable for bear habitat identified during field survey and based on bPPSn bear distribution maps (Bear Spread)</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Area covered by bPPSn bear range crossed</strong></td>
<td>Total area within the 2 km corridor suitable for bear habitat identified during field survey and based on bPPSn bear distribution maps (Bear reappearance areas)</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Total area of ‘wetland’ type habitats</strong></td>
<td>Area of the working strip supporting all wetland habitats including running and standing water.</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Total number of river crossings in rivers of perennial flow</strong></td>
<td>Number of expected river crossings, considering only those rivers with a permanent flow (rivers of ephemeral – rivers of permanent flow). It does not include the irrigation channels located East of Potamos river</td>
<td>Num. rivers</td>
</tr>
<tr>
<td><strong>Area with slope degree &lt;33° (slope lower 2V:3H)</strong></td>
<td>Area of the working strip of the route on slopes &gt;33°</td>
<td>ha</td>
</tr>
<tr>
<td><strong>Area of serpentine soils to be cleared</strong></td>
<td>Total area within the working strip potentially supporting critical areas for endemic plant species identified during field survey and based on geological features.</td>
<td>ha</td>
</tr>
<tr>
<td>Impact Indicator</td>
<td>Definition</td>
<td>Units</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Archaeological Site or high potential site/location</td>
<td>Number of archaeological Sites or High Potential location within the 2 km corridor, where a site is defined as any area with known or strongly suspected to have ancient below-ground cultural remains, artifacts, architectural foundations, or soil features (e.g. tomb, buried settlement or fortification, prehistoric camp site or village).</td>
<td>Site = 6 points</td>
</tr>
<tr>
<td>Monument (old building)</td>
<td>Number of Monuments within the 2 km corridor where Monument is defined as an above ground structure with historic characteristics (e.g. old church, reconstructed ancient site, historic graveyard, old neighbourhood, any type of historic structure that is preserved above ground).</td>
<td>Site = 3 points</td>
</tr>
<tr>
<td>ICH (new churches and other resources)</td>
<td>Number of Intangible Cultural Heritage sites within the 2 km corridor, where a ICH is defined as a place, structure, or other physical feature that has cultural importance not because of its special physical characteristics but because of its importance to a local group or community (ICH most often has no legal protection).</td>
<td>Site = 1 point</td>
</tr>
<tr>
<td>Overall Archaeological Potential of Corridor</td>
<td>Total area and percentage of highly productive agricultural land within the 2 km corridor according to CORINE DATA</td>
<td>ha and % of 2 km corridor</td>
</tr>
</tbody>
</table>
### Socio-Economic Impact Indicators

<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics and Settlements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional stakeholders</td>
<td>Total number of regions crossed by the route</td>
<td>Number of regions</td>
</tr>
<tr>
<td>Local government stakeholders (Municipalities)</td>
<td>Total number of municipalities crossed by the route</td>
<td>Number of municipalities</td>
</tr>
<tr>
<td>Settlements located within the corridor (based on the X,Y coordinate layer)</td>
<td>Total number of settlements within the 2 km corridor. Settlement identification based on the X,Y coordinate official layer</td>
<td>Number of settlements</td>
</tr>
<tr>
<td>Population in settlements within the 2 km corridor (based on the X,Y coordinate layer)</td>
<td>Total number of residents within settlements located in the 2 km corridor. Settlement identification based on the X,Y coordinate layer. Population data is from 2001 (date of last census).</td>
<td>Number of Residents</td>
</tr>
<tr>
<td>Population density within the 2 km corridor (based on the X,Y coordinate layer)</td>
<td>Number of residents per square kilometre of the Study Area. Settlement identification based on the X,Y coordinate layer</td>
<td>Inhabitants /ha</td>
</tr>
<tr>
<td>Settlements with area boundaries crossing the corridor routes (based on the settlement polygon layer)</td>
<td>Total number of settlements with some portion of territory crossing the 2 km corridor. Settlement area based on the settlement polygon layer.</td>
<td>Number of settlements</td>
</tr>
<tr>
<td>Population in settlements along the 2 km corridor (based on the settlement polygon layer)</td>
<td>Total number of residents within settlements located in the 2 km corridor. Settlement identification based on the polygon layer. Population data is from 2001 (date of last census).</td>
<td>Number of Residents</td>
</tr>
<tr>
<td>% of the municipalities’ population living along 2 km corridor (based on the settlement polygon layer)</td>
<td>Percent of the total population of all municipalities crossed by the route that live in settlements within the corridor.</td>
<td>%</td>
</tr>
<tr>
<td>Settlements 1 km outside the 2 km corridor but potentially accessing resources within the corridor</td>
<td>Total number of settlements located in the area 1 km either side of the 2 km corridor. Settlement identification based on the X,Y coordinate official layer.</td>
<td>Number of settlements</td>
</tr>
<tr>
<td>Population in settlements located 1 km outside the 2 km corridor but potentially accessing resources within the corridor</td>
<td>Total number of residents in settlements that are outside the corridor but identified in above indicator. Settlement identification based on the X,Y coordinate official layer.</td>
<td>Number of Residents</td>
</tr>
<tr>
<td><strong>Local Economy, Land Use and Livelihoods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area of agricultural lands</td>
<td>Area of the 2 km corridor and the working strip classified as agricultural land by the CORINE² Land Cover database</td>
<td>ha</td>
</tr>
</tbody>
</table>

(1) Two layers regarding settlements have been created. The official layer is only providing x,y coordinates of the centre of the settlements while the polygon layer is actually providing the settlement boundaries.

² Coordinate Information on the Environment Land Cover database – depending on the data within the vegetation maps this data source may be used instead to ensure consistency with the
<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Definition</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of permanently irrigated agricultural land</td>
<td>Area of the 2 km corridor and the working strip classified as permanently irrigated agricultural land by the CORINE Land Cover database</td>
<td>ha</td>
</tr>
<tr>
<td>Area of grazing lands</td>
<td>Area of the 2 km corridor and the working strip classified as grazing land by the CORINE Land Cover database</td>
<td>ha</td>
</tr>
<tr>
<td>Area of permanent crops along the 2 km corridor (CORINE)</td>
<td>Area of the 2 km corridor and the working strip classified as area of permanent crop cultivation by the CORINE Land Cover database</td>
<td>ha</td>
</tr>
<tr>
<td>Area of permanent crops along the 2 km corridor (municipality data)</td>
<td>Area of the 2 km corridor and the working strip identified as an area of permanent crop cultivation by municipality officials and landsat imagery</td>
<td>ha</td>
</tr>
<tr>
<td>Area of mineral extraction</td>
<td>Area of the 2 km corridor and working strip classified as having active coal mines or deposits by PPC.</td>
<td>ha</td>
</tr>
<tr>
<td>PPC concession areas</td>
<td>Area of the 2 km corridor and working strip classified as PPC concession areas.</td>
<td>ha</td>
</tr>
<tr>
<td>Area occupied by industrial and commercial units</td>
<td>Area of the 2 km corridor and working strip classified as industrial and commercial area by the CORINE Land Cover database</td>
<td>ha</td>
</tr>
<tr>
<td>Settlements reliant on agriculture as their main economic activity (polygon)</td>
<td>Number of settlements within the 2 km corridor that rely on crops, livestock, forestry, or hunting as their main source of livelihoods and income (2001 census data).</td>
<td>Number of settlements (% of total within the corridor)</td>
</tr>
<tr>
<td>Settlements reliant on industry as their main economic activity (polygon)</td>
<td>Number of settlements within the Study Area whose livelihood and main source of income is a work in industry or manufacturing (2001 census data)</td>
<td>Number of settlements (% of total within the corridor)</td>
</tr>
<tr>
<td>Settlements reliant on mineral extraction as their main economic activity (polygon)</td>
<td>Number of settlements within the Study Area for which the primary source of income is work in mines or quarries (2001 census data).</td>
<td>Number of settlements (% of total within the corridor)</td>
</tr>
<tr>
<td>Settlements with a diversified economy (polygon)</td>
<td>Number of settlements within the 2 km corridor whose livelihood is based on a mixture of economic activities (agriculture, light industry, services, government jobs, etc.)</td>
<td>Number of settlements (% of total within the corridor)</td>
</tr>
</tbody>
</table>

**Access to Infrastructure and Services Provision**

<table>
<thead>
<tr>
<th>Access to utilities (energy, water, sewerage), (polygon)</th>
<th>Number of settlements within the 2 km corridor with access to all utilities</th>
<th>Number of settlements (% of total within the corridor)</th>
</tr>
</thead>
</table>

environment team. However, the availability of data on agriculture (in particular permanent crops) is unclear at this time and will need further investigation to define best approach.
4.4 BIOLOGICAL ENVIRONMENT

4.4.1 Introduction

This Section presents the baseline description of the biological environment for the 2 km wide study corridor along the entire route of the Project, from Nea Mesimvria to the Greek-Albanian border.

The Project will initially cross the Thessaloniki - Giannitsa plateau which encompasses the downstream sections of four major river systems: Axios, Aliakmonas, Loudias and Gallikos. This area has an average altitude of less than 200 m above sea level (a.s.l.) and until the late 1920s was partially inundated creating the Giannitsa marsh which covered thousands of hectares. The marshland was drained in the early 1930s for agricultural use and water was extracted from the river systems for crop irrigation. The remaining, ‘heavily-modified’ waterbodies that cross the plateau are still used for irrigation purposes.

Vermio Mountain lies immediately west of the Thessaloniki - Giannitsa plateau; its highest summit lies above the timberline (above 2,000 m a.s.l.) nevertheless almost the entire mountain is covered by dense deciduous forests, with pine stands being less common. The western slopes of Vermio Mountain face the Eordea plateau where major urban centres and industrial activities are present. The Eordaia plain lies between 400 – 800 m a.s.l. and is crossed by several tributaries of the Aliakmonas River or streams that flow into the lake systems of the area (Chimaditida, Zazari, Petron and Vegoritida). In the northwest of the Eordea plateau, Vernon (Vitsi) Mountain stands which continues into Askio (Siniatsiko) Mountain to the southeast and further south to Mount Vourinos. The summits of both Vernon and Askio mountains rise above 2,000 m a.s.l. To the west, towards the Greek-Albanian border, and
south of Kastoria Lake, the landscape is predominantly hilly with patches of cultivated land grasslands and forests dissected by watercourses that flow into the upstream section of Aliakmonas River.

### 4.4.2 General Description of the Land Use in the Study Area

About 82% of West Macedonia is mountainous or semi-mountainous. The limited agricultural areas of the region are mostly cultivated annual crops such as wheat beans. In Central Macedonia annual crops mostly comprise cotton and sugar beet but there are also areas with permanent crops such as apples, kiwis and cherries. A breakdown of the regions land use types is given below.

#### Table 4-4 Land Use Types for the Regions of Central and West Macedonia

<table>
<thead>
<tr>
<th>Land use types</th>
<th>Central Macedonia, %</th>
<th>West Macedonia, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry and woodland</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td>Shrubland</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Pastures</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Barren, urban land and water</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Arable land</td>
<td>34</td>
<td>27</td>
</tr>
</tbody>
</table>

*Source: Ministry of Environment, Energy and Climate Change*

### 4.4.3 Description of Flora and Vegetation in the Study Area

*Flora Species*

The flora of the Study Area includes species growing from the lowlands to montane, sub-alpine and alpine levels, in a variety of habitats, such as deciduous and evergreen forest, shrubland, rivers, lakes, grasslands, screees, meadows, pastures, field margins etc.
An extensive literature review (Mathiew 1982, Strid 1986, Strid & Tan 1991, 1997, 2002, Boratynski et al. 1992, Karousou et al. 2000, IUCN 2001, Chochliouros 2005, Babalonas et al. 2009a-h, Phitos et al. 2009a, b) has identified that more than 322 plant species and subspecies (hereinafter referred to as “species”) are located in the Study Area. The field surveys have verified some of these species but it is estimated that an even larger diversity exists. The area of interest is a 50 km zone with many Natura 2000 sites located in the broader area, and routing aimed at avoiding these sites. (as shown in Figure 4-2).

**Figure 4-2** Project Study Area indicating the Natura 2000 Network

Many of the important plant species have been recorded within Natura 2000 sites that will not be impacted by the Project. The Base Case route has been designed to avoid all of the Natura 2000 sites except for the Axios River which cannot be avoided. The majority of these species have been recorded on Vermio Mountain, the flora of which has been thoroughly investigated by Chochliouros (2005).

The species considered as important are those that fulfil one or several of the criteria that follow.
Red Data Book Species

Ten species occurring in the Study Area are included in the two volumes of the Red Data Book of Rare and Threatened Plants of Greece (Phitos et al. 2009a, b). Among these, eight species (Ajuga piskoi, Aquilegia nigricans, Dactylorhiza incarnata, Geranium thessalum, Gymnadenia rheedii, Leucojum aestivum, Prometheum tymphaeum, Roemeria hybrida) are recorded as vulnerable (VU), one orchid species, Epipactis nauosaensis, as endangered (EN) and one species, Centaurea charrellii, as critically endangered (CR). Regarding the latter, its recorded presence in the region has not been confirmed recently and it might be extinct.

IUCN Red List Species

Twelve species, exclusively trees and shrubs, are included in the IUCN Red list (www.iucnredlist.org) as of least concern (eleven species) or nearly threatened (one species). These are Abies x borisii-regis, Alnus glutinosa, Corylus avellana, Juniperus communis, J. excelsa, J. foetidissima, J. oxycedrus, Pinus heldreichii, P. nigra, Platanus orientalis, Populus nigra (LC) and Juglans regia (NT).

Among the most interesting species are Alnus glutinosa (Figure 4-3) and Platanus orientalis, the latter protected by the Greek legislation. These species are dominant components of the riparian vegetation along the Aliakmonas River and its tributaries and other rivers and streams in the Study Area. Other interesting species are the Balkan endemics Abies x borisii-regis and Pinus heldreichii, which, however, have not been recorded within the Study Area.
Endemic Species

Five different kinds of endemism are distinguished within the Study Area: Greek, Greek-Albanian, Greek-Anatolian, Balkan and Balkan-Anatolian endemisms.

The Greek endemics comprise 39 species (e.g. Alysum heldreichii, Asperula aristata subsp. thessala, Centaurea charrellii, C. ossaea, Cerastium vourinense, Dactylorhiza baumanniana, Dianthus stamatiadae, Geranium thessalum, Onobrychis aliacmonia, Onosma elegantissimum, Sesleria vaginalis and Silene haussknechtii). Most of these species occur outside the wider Study Area on Siniatsiko, Vermio, Vourinos and Gramos mountain ranges and grow in open, rocky habitats. Eleven out of these 39 species are protected by the Greek legislation and two are included in the Greek Red Data Book.
The Greek-Albanian endemics comprise 33 species that grow in rocky habitats, screes, meadows, grasslands and pastures. Most of these species predominantly occur on the Gramos mountain range but also on Vourinos, Vermio, Siniatsiko and Vitsi mountains. Five of them (*Allium phthioticum*, *Alyssum smolikanum*, *Campanula hawkinsiana*, *Lilium chalcedonicum*, *Valeriana crinii* subsp. *epirotica*) are protected by Greek law.

The Balkan endemics constitute the largest endemic element in the Study Area, comprising 178 species. Only 17 species (approximately 10%) are protected by Greek legislation. Six Balkan-Anatolian endemics, i.e. species endemic to the Balkan Peninsula and Anatolia (Turkey except European part), have been recorded.

Among the endemic elements listed above, there are several species that grow on serpentine substrate. The serpentine endemics constitute a rich and interesting floristic element of the Balkan Peninsula (Stevanovic et al. 2003). In Greece the most extensive areas with serpentine substrate are in the north and northwest of the country (Strid & Tan 1997). Within the Study Area a total of 44 serpentine endemic species have been recorded, 15 of which are obligate and 29 casual (facultative or accidental) serpentine endemics (see...
Table 4.5). Most of the obligate serpentine endemics occur in Gramos and Vourinos mountains and outside the Study Area. However, a non-obligate serpentine endemic, *Colchicum doerfleri* (Figure 4-4) was recorded during field surveys within the 2 km zone in several stands on Vermio Mountain.

**Table 4-5** Serpentinic Substrate Associated Species occurring in the Study Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Obligate Serpentine Endemics</th>
<th>Faculative or Accidental Serpentine Endemics</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Achillea abrotanoides</em></td>
<td>+</td>
<td>+</td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Achillea holosericea</em></td>
<td>+</td>
<td>+</td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Allium phthioticum</em></td>
<td>+</td>
<td>+</td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>Alyssum smolikanum</em></td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>Aquilegia vulgaris</em></td>
<td>+</td>
<td></td>
<td>E. Europe</td>
</tr>
<tr>
<td><em>Arenaria conferta</em> subsp.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>serpentinii</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Asperula aristata</em> subsp.</td>
<td>+</td>
<td>+</td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>nestia</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Bormuellera baldaccii</em></td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>Campanula hawkinsiana</em></td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>Carum graecum</em> subsp.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>serpentinicum</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Centaurea epirota</em></td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>Cerastium banaticum</em> subsp.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>speciosum</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cerastium vourinense</em></td>
<td>+</td>
<td></td>
<td>Greek endemic</td>
</tr>
<tr>
<td><em>Colchicum doerfleri</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Cynoglossus barrelieri</em> subsp.</td>
<td>+</td>
<td></td>
<td>widely distributed</td>
</tr>
<tr>
<td><em>serpentinicum</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dianthus deltoides</em> subps.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>degenii</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dianthus haematocalyx</em> subsp.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>pindicola</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dianthus integer</em> subsp.</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>minutiflorus</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Dianthus stenopetalus</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Erysimum microstylum</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Fumana bonapartei</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Galium speciosum</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Herniaia pammassica</em> subsp.</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>pammassica</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Hypericum rumeliacum</em> subsp.</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td><em>apollinis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Linum hyloteleum</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td><em>Minuartia garckeana</em></td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Species</td>
<td>Obligate Serpentine Endemics</td>
<td>Facultative or Accidental Serpentine Endemics</td>
<td>Distribution</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Orobanche rechingerii</td>
<td>+</td>
<td></td>
<td>widely distributed</td>
</tr>
<tr>
<td>Paronychia macedonica</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Saponaria sicula subsp. intermedia</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Scabiosa taygetea subsp. portae</td>
<td>+</td>
<td></td>
<td>widely distributed</td>
</tr>
<tr>
<td>Silene caesia</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td>Silene fabarioides</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Silene haussknechtii</td>
<td>+</td>
<td></td>
<td>widely distributed</td>
</tr>
<tr>
<td>Soldanella pindicola</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Stachys plumosa</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Stachys recta subsp. baldacci</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Stachys scardica</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Thlaspi microphyllum</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td>Thlaspi tymphaeum</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Thymus boissieri</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Thymus teucrioides subsp. alpinus</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td>Trifolium pignanti</td>
<td>+</td>
<td></td>
<td>Balkan endemic</td>
</tr>
<tr>
<td>Trinia glauca subsp. pindica</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td>Viola albanica</td>
<td>+</td>
<td></td>
<td>Greek-Albanian endemic</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

Note: Obligate serpentine endemics: Endemics which are mainly growing on serpentine; Facultative serpentine endemics: Endemics often growing on serpentine but also inhabiting other kinds of substrate. Accidental serpentine endemics: Endemics mainly growing on non-
serpentine substrate (limestone or silicate) but sometimes (or rarely) on serpentine.
Classification of serpentine endemics according to Stevanovic et al. 2003

Species Protected by the Greek Law

A total of 65 plant species are protected by the Greek law (Presidential Decree 67/81). This applies to ca. 20% of the total important plant species found in the Study Area. Among these, eleven are Greek endemics, 17 are Balkan endemics, five are Greek-Albanian endemics, two are Balkan-Anatolian endemics and one is Greek-Anatolian endemic. Moreover, two species are included in the Greek Red Data Book (*Centaurea charrellii*- CR, *Dactylorhiza incarnata*-VU) and further two species in the IUCN Red list (*Juniperus excelsa, Platanus orientalis*); the latter ones however, are common in Greek flora. *Annex V* includes the flora species found in the Study Area, including its protection status.
4.4.4 Vegetation

The Study Area hosts a variety of vegetation formations from lowlands to montane areas including evergreen and deciduous shrubland and forests, riparian forests, dry and wet grasslands and meadows. The main vegetation types occurring in the Study Area are described in the following paragraphs.

Deciduous and Evergreen Shrubland

Mixed deciduous and evergreen shrubland occurs as a result of degradation of the Ostryo-Carpinion alliance. It consists of rather tall shrubs (2-5 m), which are usually dense and have a poor understory of herbs. In cases of degradation caused by overgrazing or fire, the shrubs are loose and low and may have a richer understory. Dominant species are the common evergreen sclerophyllous Quercus coccifera and Juniperus oxycedrus (Figure 4-5) and several deciduous species, such as Carpinus orientalis, Ostrya carpinifolia, Cercis siliqueastrum, Paliurus spina-christi, Cotinus coggyria etc.

Figure 4-5 Mixed Deciduous and evergreen shrubland dominated by Quercus coccifera and Juniperus oxycedrus (Veroia)
Very loose shrubland consisting almost exclusively of Juniperus oxycedrus or J. oxycedrus and Paliurus spina-christi is common in the Study Area covering hills that surround flat cultivated areas and is probably a result of degradation. Such vegetation occurs within the Study Area on the eastern foothills of Vermio and north of Inoi village.

Deciduous Forests

Mixed broadleaved forests dominated by oaks (Quercus spp.) The mixed broadleaved forests chiefly dominated by Quercus species constitute one of the most common forest types in Greece holding 22.6% of the total forest cover in the country (Figure 4-6). Especially Q. frainetto forests constitute 1/3 of the Greek forest and 80% of the oak forests. They grow at an elevation of ca. 600-1,200 m, on various substrates (flysch, schist, limestone).

Mixed broadleaved forests are the most frequent forest type in the Study Area. They usually form, however, rather small stands among cultivated areas, giving evidence of a former extensive distribution restricted due to human activity. Dominant species are Quercus frainetto, Q. pubescens, Q. cerris, Q. petraea, Q. trojana, Carpinus orientalis, Crataegus monogyna, Castanea sativa, Ostrya carpinifolia, Corylus avellana, Acer monspessulanum Acer spp. Evergreen species growing in the understory are Juniperus oxycedrus, J. communis, Quercus coccifera and Paliurus spina-christi.

Among the most interesting forests here are those with Quercus trojana and those with Castanea sativa. Q. trojana forests are degraded oak forests with restricted occurrence within their range in Greece and their conservation is thus necessary. Q. trojana is one of the rarest oak species in Greece, growing exclusively in the NW continental part of the country. C. sativa forests (pure or mixed) are of high ecological importance because they are rare in Greece (1% of total Greek forest cover) and have rich flora and fauna.
Figure 4-6  Mixed broadleaved forest dominated by oaks (Vermio)

The most extensive mixed broadleaved forests in the Study Area were observed on the south and southwestern slopes of Verno Mountain near Cheimaditida and Zazari lakes and on the northwestern foothills of Vermio.

Interesting species growing in the mixed broadleaved forests within the Study Area are the Balkan endemic *Colchicum doerfleri* and the Balkan-Anatolian endemic *Crocus chrysanthus*.

*Beech Forests (Fagus sylvatica)*

*Fagus sylvatica* forests in the Study Area occur mainly on the mountains Vermio (*Figure 4-7*), Verno, Vourinos, Siniatsiko, Gramos, Voras, Pieria and at Prespa Lake. They are among the rarest forest types in Greece, holding only 5.17% of the country’s forest cover. They are restricted in the northern and central mountainous parts of the mainland, at ca. 800–1,700 m and develop on acid, acid to neutral or rarely calcareous substrates. The beech forests growing on calcareous substrates (e.g. Siniatsiko, Voras, Prespes) host a rich understory including several orchid species.
In the Study Area beech forests are often mixed with other broadleaved tree species, mainly oaks (*Quercus* spp.), but also with *Castanea sativa*.

Beech forests in Greece are managed by Forest Agencies and do not face severe threats like fires, grazing or illegal felling.

**Figure 4-7**  Beech forest (Vermio)

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**Coniferous Forests**

Black pine (*Pinus nigra*) forests are the most frequent coniferous forests within the Study Area (*Figure 4-8*). Black pine forests in Greece grow on dry rocky slopes between 600 and 1,700 m, on dolomitic or ophiolitic substrate (high tolerance to magnesium). They belong to the rarest forest types of Greece, constituting 4.33% of the forest cover of the country. Furthermore, they are a priority habitat type for Europe according to the Directive 92/43. In the Study Area, black pine forests occur in the Vermio and Vourinos mountains. Patches of planted black pines are found within the *Fagus sylvatica* forest in the corridor at the south-southeastern foothills of Verno Mountain and on the
northern slopes of Vermio Mountain. The area close to the Albanian border, also hosts planted and natural forest of black pines mixed with *Quercus* spp.

**Figure 4-8** Coniferous forest dominated by *Pinus nigra* (Vermio)

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**Grasslands, Meadows and Pastures**

This vegetation appears in open areas dominated by herbs, grasses, geophytes and loose scattered trees and shrubs in forest openings, abandoned arable land or above the timberline.

Several semi-natural dry grassland communities develop on mountainous regions of the Study Area. Among the most interesting are the species-rich *Nardus* grasslands, a priority habitat type according to the European Directive 92/43. This habitat type occurs mostly in Verno and Pieria mountains above 1,600 m in flat or almost flat areas. Other interesting grasslands are the semi-natural dry grasslands and scrubland facies of the *Festuco-Brometalia*, which occur in Vermio, Vourinos and Pieria mountains and host several endemic and orchid species (Dafis et al. 2001).
Wet meadows are scattered in openings of beech or other type of montane forest, mainly on non calcareous substrates. Typical species found in wet meadows include *Silene asterias*, *Geum coccineum*, *Parnassia palustris*, *Juncus thomassii*, *Scirpus sylvaticus*, *Stellaria graminea*, *Filipendula ulmaria*, *Doronicum austriacum* and *Potentilla erecta*. Drier meadows, forest clearings and pastures have a rich flora of perennial herbs, geophytes and grasses (Strid & Tan 1997). Wet meadows have been observed within the Study Area at the northern foothills of Vermio in a *Fagus sylvatica* forest opening.

**Figure 4-9** Subalpine grassland (Verno)

Grasslands, pastures and meadows at montane and especially subalpine (*Figure 4-9*) and alpine levels are of high botanical value since they host numerous rare, endemic and protected species (Strid 1986, Strid & Tan 1991, Dafis et al. 2001). Interesting species here are the protected Greek endemic orchid *Dactylorhiza baumanniana*, growing in wet meadows above 1,050 m in Vermio, Vourinos and Gramos mountains and the Greek-Albanian endemic *Marrubium thessalum* growing on rocky places in subalpine and alpine pastures above 1,100 m in Siniatsiko and Vourinos mountains.
Riparian and other Wetland Vegetation

Riparian forests or galleries develop along the Aliakmonas River and its tributaries, as well as several other rivers and streams flowing in the western part of the Study Area, such as the Kilada River and Amyntas stream. In the eastern part of the Study Area extensive stands of riparian forest develop at the Axios River. Other rivers (e.g. Loudias) and streams flowing in the Thessaloniki-Giannitsa plain are usually converted to irrigation channels and are dominated by reeds (*Phragmites australis*).

**Figure 4-10** Riparian Forest dominated by *Platanus orientalis* (Vermio)

There are three different habitat types of riparian forests in the Study Area: Riparian forests dominated by *Populus* and *Salix* species, riparian forests dominated by *Platanus orientalis* and Residual alluvial riparian forests dominated by *Alnus glutinosa* (EU priority habitat type). The most distinct among the three are the *Platanus orientalis* forests which are usually monospecific (*Figure 4-10*). Examples of *Platanus orientalis* forests are found along and the stream crossing the settlement of Kato Grammatiko. The other two riparian habitat types are mainly found along Aliakmonas and tributaries and often show mixed occurrence (co-dominance of *Salix* species, *Populus* species and *Alnus glutinosa*). These forests, although in most cases restricted
in small stands at either sides of the rivers, have a rather interesting biodiversity, including a high number of associated species, such as *Populus alba*, *P. nigra*, *Salix alba*, *S. eleagnos*, *S. amplexicaulis*, *S. purpurea*, *Alnus glutinosa*, *Platanus orientalis*, *Fraxinus angustifolia*, *Juglans regia*, *Ulmus glabra*, *U. minor*, *Cornus sanguinea*, *Corylus avellana*, *Sambucus nigra*, *Tamarix* spp. and *Rubus* sp.

Six lakes are found within the wider Study Area (Kastoria, Vegoritida, Petron, Cheimaditida, Zazari, Agra lakes). The lakes are mostly surrounded by agricultural land. Natural vegetation developing around the lakes includes mainly stands with reeds (*Phragmites australis*, *Scirpus* sp., *Typha* sp.), dry and humid grasslands. At Petron and Vegoritida lakes there are stands with semi-natural dry grasslands and short-grass annual grasslands rich in therophytes, which are priority habitat types according to the EU Habitats Directive 92/43. Scattered small stands of riparian forest with *Salix* spp., *Populus* spp., *Alnus glutinosa* or *Platanus orientalis* are found around the lakes as well.

### 4.4.5 Fauna Species

The Study Area comprises the largest lake systems in Greece as well as several river valleys with their estuaries. Despite the fact that the lowlands mainly comprise agricultural land, they still host some species of conservation interest such as *Spermophilus citellus* and *Circus pygargus*.

The purpose of this section is to provide information on the range and abundance of animal species within the Study Area, including estimations of species richness and rarity factors if available. Emphasis is given on animal groups which are considered relatively well-studied so the current knowledge on their range and population density is less affected by biased sampling effort. As a result the groups principally discussed within this section are the vertebrates and the Papilionoidea (Lepidoptera) and Odonata taxa among the invertebrates.

Taxa under national and/or international threat categories are more explicitly presented as they are considered of particular conservation interest.

#### Mammals

The Study Area hosts some of the largest terrestrial mammals in Greece. The bear (*Ursus arctos*) has a well-established population in Mount Grammos with
A maximum of 41 individuals (southwestern part of the Study Area) and has expanded towards other mountains of western Macedonia since the end of the 80s. The Vernon (Vitsi) Mountain and Siniatsiko (Askio) Mountain are parts of the mountainous range where the bear is constantly present. Recordings in Vermio are thought to belong to vagrant animals and there is no evidence of a permanent population there. Bear are protected under Greek legislation and are an “endangered” species according to the Red Data Book - Greece.

Analysis of habitat use for the Mount Grammos bear population has shown that mixed agroforestry habitats are a habitat type commonly used. Mixed broadleaved forests with Castanea sativa and Corylus avellana are also extensively used; home range sizes vary extensively between male and female animals and between different seasons rising up to hundreds of square kilometers. As a result, it seems that the species is well dispersed within the whole mountainous part of the Study Area although the status of the population in certain regions (constant, vagrant) may differ or may vary from year to year often as a result of transboundary movement. Research projects currently run under the auspices of NGOs “Arcturos” and “Kallisto”.

The wolf (Canis lupus) is known to occur throughout western Macedonia in middle and high altitudes wherever there is food availability. The species is less dependent on the habitat type per se and more dependent on the presence of free-ranging herds. The total Greek population is estimated at 600 individuals but it could be higher. Local populations are difficult to estimate as the wolf packs have large ranges which extend to hundreds of kilometers and they may cross the borders of Greece in several cases. The wolf in Greece is considered as Vulnerable according to the Red Data Book - Greece.

With the exception of the otter (Lutra lutra), the rest of the Carnivora species (Mustela nivalis, Meles meles, Vulpes vulpes, Martes foina, Felis silvestris) are apparently widespread in the Study Area. The otter (Lutra lutra), considered as Endangered according to the Red Data Book - Greece, is definitely known to be present in western Macedonia but there are few data regarding its status or its local abundance: the species’ home range varies enormously and it is much dependent on the condition of any water bodies within the region. Wetlands that preserve water through the year and have persisting fish populations are of vital importance for the species.

Western Macedonia falls within the range of two mole species: Talpa caeca (endemic of south Europe) and Talpa stancovici (Balkan endemic). They are
considered in Greece as Data Deficient and Least Concern, respectively, according to the Red Data Book - Greece Both inhabit deciduous woodlands, meadows and pastures and can be sympatric. Indeed, one of these species, or maybe both, is sure to inhabit the Study Area as their nests have been observed in the field.

Several Insectivora and Rodentia species are also recorded from the area: there are four species of shrews (*Crocidura leucodon, C. suaveolens, Neomys anomalus, Sorex minutus*) with reports from several sites within the Study Area: it is unknown whether indeed they show clustered distribution or sampling efforts have been insufficient to describe their whole biogeographical range. The genus *Microtus* is of particular interest: all five species (*Microtus thomasi, M. rossiameridionalis, M. subterraneus, M.guenteri, M.felteni*) are recorded from western Macedonia often being sympatric. The rarest (considered “Endangered” according to the Greek Red Data Book and Data Deficient for IUCN) is *Microtus felteni*, a Balkan endemic species of which there are only few records, some recent ones from Vermio Mountain.

*Spermophilus citellus* is, from a conservation point of view, one of the most important species within the Study Area; the European souslik which lives in colonies and leads a fossorial existence in underground tunnel systems. The species is found in short-grass steppes, abandoned cultivations or grasslands habitats. It is reported from a few sites within the Study Area including the valley of Axios, Kozani and the fields of Giannitsa but their status or precise location in not known.

There are only two representatives of Artiodactyla within the Study Area: the roe deer (*Capreolus capreolus*) and the wild boar (*Sus scrofa*). The latter could be present due to deliberate introductions. The status of the roe deer is unknown but it could be present in forested areas across several mountainous sites.

With regards to Chiroptera (bats), thirteen species have been reported in the Study Area. This is undoubtedly due to the limited research on this group, conducted in the area rather that the true situation as the majority of the approximately thirty four bat species occurring in Greece can be assumed to occur in the Study Area. Bats require both shelters and foraging habitat: Most of the 13 species recorded in the Study Area use caves as shelters, while others use tree holes and buildings (however the apparent preponderance of cave-dwelling species may be due to researcher bias for caves). As far as
foraging habitat is concerned, woodland and forests are the most important habitats, followed by wetlands, open country (grassland, scrub, etc.) and farmland.

Three of the species found in the area are globally threatened or near threatened, while five are nationally threatened. Nevertheless, at a national level, there are no Critically Endangered or Endangered species among the bats recorded, and only one is classified as Vulnerable (this is the Daubenton’s Bat Myotis daubentonii, recorded in Gavros and north of Kastoria).

Reptiles

The Study Area remains an insufficiently studied area as far as reptiles are concerned. Some information exists with regards to the species richness of the Prespa region which is approximately 15 km north of the western portion of the route in which relatively high reptile species richness has been recorded (24 species per 10 km²)

The lowlands of the Study Area are considered poor with regards to species richness but mountainous sites present greater richness. With the exception of the Eurotestudo hermanni², no other species from the Study Area are included in the Greek Red Data book³, and most have a quite extensive range even though there is lack of information with regards to their abundance.

Amphibia

There are twenty two amphibian species in Greece (approximately a third of the European species). Thirteen taxa are estimated to be present in the Study Area and most of them widely distributed.

Birds

The studies published of the avifauna of the Project region mostly involve the wetland areas, while relatively little information is available concerning the mountainous areas.

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1 The terrapin Emys orbicularis is described as “Near Threatened”
2 or else Testudo hermanni
3 http://www.iucnredlist.org/apps/redlist/details/59472/0/rangemap
A total of 69 bird species (most of them water birds) recorded in the Study Area are listed in the Greek Red Data book, IUCN and/or BirdLife International. Among these species, 21 are at least partly resident (R), 37 are summer visitors and breeders (SV), 7 are winter visitors (W), while 4 are only passing through the area (MP).

The most important species occur in the major wetlands in the area outside the Study Area. One of the largest heron colonies in Greece, as well as colonies of gulls, terns, avocets (*Recurvirostra avocetta*) and collared pratincoles (*Glareola pratincola*) is located in the Axios Delta (which assembles the deltas of Axios, Gallikos, Loudias and Aliakmonas rivers). In winter, the delta hosts large numbers of ducks, including the largest wintering population of Shelduck (*Tadorna tadorna*) in Greece; this species also breeds in the deltas. Among the wintering species present in the Axios Delta, there are populations of the Dalmatian Pelican (*Pelecanus crispus*) and Pygmy Cormorant (*Phalacrocorax pygmeus*). Raptors present in the Delta include breeding White-tailed Sea Eagles (*Haliaetus albicilla*) and wintering Greater Spotted Eagles (*Aquila clanga*).

In Kastoria Lake there is a heron colony, and also resident and breeding populations of Pygmy Cormorants. This lake is the most important in Greece for wintering Goosanders (*Mergus merganser*). It hosts an important population of Ferruginous Ducks (*Aythya nyroca*), as well as other waterbirds breeds in Lakes Chimaditis and Zazar.

Concerning the hills and mountainous areas, there are breeding raptors such as the Golden Eagle (*Aquila chrysaetos*) and the Lanner Falcon (*Falco biarmicus*), while the forests host Black Storks (*Ciconia nigra*), as well as several species of woodpeckers. Farmland also hosts some important species, including Montague’s Harriers (*Circus pygargus*) and Lesser Kestrels (*Falco naumanni*) which are know, both, to breed in the Olympias – Galatea plateau.

Data on woodpeckers and passerines are limited. For example, the Lesser Grey Shrike (*Lanius minor*) is reported from Mount Vourinos and the Short-toed Lark (*Calandrella brachydactyla*) from Axios Delta, but both are almost certainly found in other areas as well.

The presence of so many rare and threatened species in the area is due to the variety of available habitats. Thus, 26 species are associated with wetlands,
18 with farmland and urban areas, 14 with grassland and other open areas, 6 with forests and woodlands and 5 with scrubs.

Among the 69 species mentioned, 9 are globally threatened or near threatened according to IUCN, while 42 (62%) are of national conservation concern. At a national level, 8 species (21%) are Critically Endangered, 11 (16%) are Endangered, 14 (20%) are Vulnerable and 9 (13%) are Near Threatened (see Table 4.6). The rest of the species are considered as Data Deficient, Least Concern, or Not Evaluated in the Red Data Book.

### Table 4-6

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Latin Name</th>
<th>Greek name</th>
<th>English name</th>
<th>Greek Red Data Book Threat Status</th>
</tr>
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<tr>
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<td>Tadorna tadorna</td>
<td>Varvara</td>
<td>Shelduck</td>
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<td>Goosander</td>
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<td>4</td>
<td>Pelecanus onocrotalus</td>
<td>rodopelekanos</td>
<td>White Pelican</td>
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<tr>
<td>5</td>
<td>Pelecanus crispus</td>
<td>argiropelekanos</td>
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<td>Circaetus gallicus</td>
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<td>Lesser Kestrel</td>
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### Table: Birds in the Study Area

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Latin Name</th>
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<th>English Name</th>
<th>Greek Red Data Book Threat Status</th>
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<td>Recurvirostra avocetta</td>
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<td>Numenius tenuirostris</td>
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<td>Larus melanocephalus</td>
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<tr>
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<td>Sternum albifrons</td>
<td>nanoglaronon</td>
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<td>Coracias garrulus</td>
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<td>Picus canus</td>
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<td>Dendrocoptes leucotos</td>
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<td>Alauda arvensis</td>
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<td>42</td>
<td>Lanius minor</td>
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<td>Lesser Grey Shrike</td>
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</tbody>
</table>

The majority of the Red Data Book bird species are well known regarding their breeding and wintering populations and therefore current knowledge on their range is considered representative of the true situation. It should be stated that at least the waterbirds are mostly confined within the large lake systems and the Axios-Aliakmonas-Loudias estuary with the two mentioned pelican species (Dalmatian and White Pelicans) breeding only in Lake Mikri Prespa.

The pygmy cormorant has breeding colonies in Axios Delta, Mikri Prespa and/or Kastoria Lakes. Together with herons breed Spoonbills and Glossy Ibises (in Mikri Prespa Lake and Axios Delta). Other colonial waterbirds include gulls and terns, which breed mainly in the deltas.

Among ducks, the globally threatened Ferruginous Duck breeds in Chimaditis and Kastoria Lakes, but it occurs in the other wetlands in migration. In Greece, the Goosander breeds only in the Prespa Lakes; most of them move in Kastoria Lake in winter, which is the most important wintering site for the species in the country.
The raptors are not very well known in the Study Area; most are reported only by general references without specific sites. The Golden Eagle breeds near Lake Chimaditis, but probably in other mountainous areas as well, while the Lanner Falcon is reported to breed in Mount Vourinos (but it also could be present elsewhere in the area). The wider area is the main stronghold in Greece for breeding Montague’s Harriers, which have only a small breeding population in the country. They have been recorded as breeding in the Olympias – Galatea plateau and near Vegora, but it is possible that they also breed elsewhere. The former area also hosts a colony of Lesser Kestrels (again, this species may also possibly breed in other areas).

Data on woodpeckers and passerines are limited. For example, the Lesser Grey Shrike (Lanius minor) is reported from Mount Vourinos and the Short-toed Lark (Calandrella brachydactyla) from Axios Delta, but both are almost certainly found in other areas as well.

The great majority of the birds covered in this section (64 out of 69 species) are protected by national laws and regulations. The rest can be hunted in compliance with hunting seasons and quotas.

Freshwater Fish

Main rivers crossed by the Project are the Axios and the Aliakmonas. The route crosses the Aliakmonas twice, west of Hiliodendro and north of Argos Orestiko. Other important rivers crossed include the Loudias, Potamos, Lianorrema and the Grammatikou rivers.

Information on freshwater fish species is scarce and mainly limited to the Aliakmonas water basin, which is known to host thirty eight (38) freshwater fish species of which several may also inhabit saline or brackish habitats (mostly within the delta area and downstream the Polífitos dam). The upper sections of Aliakmonas River have been extensively studied and at least eleven (11) different species were recorded in between Argos Orestiko and Microcastro. The endemicity rate in this section is high: 63% of them are Balkan endemics. In addition, three (3) species (Barbus balcanicus, Barbus macedonicus, Salmo pelagonicus) are included in Annex II and/or V of Directive 92/43 CEE.

Two (2) species (Vimba melanops, Salmo pelagonicus) are considered as Vulnerable in the Red Data Book of Greece and indeed one of them (Salmo pelagonicus) is also considered as Vulnerable according to IUCN.
species is mostly recorded in Aliakmonas’ sections north of Kastoria and in major tributaries in the south (Venetikos river); it has also been recorded from Axios River close to the border with FYROM and it is likely that it is also present in other upstream sections of smaller streams of perennial flow within the Study Area. The populations are small and rare and may be strongly impacted by human activities which involve habitat alterations.

There are thirty seven (37) and twenty (20) taxa recorded from Axios and Loudias rivers respectively, including the delta area. Freshwater fish communities may differ substantially among upstream and downstream sections due to several reasons such as habitat alterations of local character. A strong seasonal element may also be evident as sections towards the delta or river parts that are serving as irrigation channels are more likely to be influenced by freshwater scarcity.

*Invertebrates (Lepidoptera: Papilionoidea and Hesperioidea, Odonata)*

Greek butterflies have been relatively well-studied for years. Although there are still important gaps regarding the ranges of less abundant or cryptic species, there are a few objective estimations on species diversity and conservation needs for several species across the country. *Table 4.7* comprises information on species richness across different mountains within the Study Area.

<table>
<thead>
<tr>
<th>Table 4-7</th>
<th><strong>Species Richness across different mountains within the Study Area</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td><strong>Number of Papilionoidea and Hesperioidea species</strong></td>
</tr>
<tr>
<td>Mount Vermio</td>
<td>129</td>
</tr>
<tr>
<td>Mount Vitsi (Vernon)</td>
<td>164</td>
</tr>
<tr>
<td>Mount Vourinos</td>
<td>133</td>
</tr>
<tr>
<td>Mount Siniatsiko (Askio)</td>
<td>143</td>
</tr>
</tbody>
</table>

The Lepidoptera species included in the Red Data Book – Greece and recorded within the Study Area are all high-altitude taxa, with the only exception of *Lycaena dispar*, which is widely distributed in northern Greece and its presence is often connected to its host plant *Rumex hydrolapathum*, a species that is commonly found in wetlands.
Despite the fact that large sections of western and central Macedonia remain unexplored with regards to damselfly and dragonfly fauna, several Odonata species of conservation interest have been recorded from the area. Several reports refer to the large lake systems as the Prespes and Vegoritis and the Axios–Gallikos–Loudias–Aliakmonas delta as places with high species richness for this group. Other species, such as *Cordulegaster heros* and *Cordulegaster bidentata* are found in forest brooks, springs and rivulets, usually in very small populations. Such species are commonly very sensitive to disturbance if leading to desiccation or woodcutting.

### 4.4.6 Landscape and Geomorphology

The Study Area in terms of landscape and geomorphology can be coarsely divided in two sections: (a) the eastern flat section extending from the pipeline section starting point near Nea Messimvria and extending towards the west to Veroia town and (b) the mountainous western section extending from Vermio mountain towards the west to the Greek-Albanian border.

Four (4) main landscape types are recognized in the Study Area: plains with agricultural activity, hilly agricultural areas, narrow valleys with limited access and mountainous forested areas.

**Plains with Agricultural Activity**

This Landscape is flat and elevations are generally low, from sea level to ca. 50 m. It is characterized by relatively intense anthropogenic activity. These landscapes offer long views across large areas, however they are heavily influenced by anthropogenic activity and often feature linear features as roads, tracks and channels.

The eastern part of the Study Area comprises a large plain extending from the Project’s starting point in Nea Messimvria towards the north to Paiko mountain and towards the west and south to Vermio and Pieria mountains (Thessaloniki-Giannitsa plain).

Some of the major towns of the area are found here with Veroia being the largest (population ca. 43,000) followed by Giannitsa (ca. 26,000) and Alexandria (ca. 13,000).

Three major rivers flow in the plain, i.e. Aliakmonas, Axios, Loudias forming (together with Galikos River coming from the east) a common delta in the
southeastern edge of the Study Area. Riverbeds of the major rivers and their tributaries are locally diverted serving to irrigate the plain. The area around Giannitsa used to be dominated by swamps and marshes that were drained in 1928-1932.

The second largest plain, the Eordea Plain, is situated between Vermio Mountain to the east, Verno Mountain to the west and Ptolemaida town to the south. Four of the major lakes found in the Study Area are found here, namely Vegoritida, Petron, Cheimaditida and Zazari. Major urban center in the plain is the Ptolemaida town with population ca. 35.000.

Cultivations in the plains include several cereals (wheat, barley, maize), rice, cotton, burclover and fruit orchards (peach, apricot, apple, cherry, and pear).

Riparian vegetation along irrigation channel is restricted and comprises mainly by reeds, but some interesting riparian species, like *Alnus glutinosa*, may occasionally occur.

**Hilly Agricultural Areas**

The gently sloping hilly parts of the Study Area form a mosaic of agricultural land, stands of oak forest and human settlements. These forest stands are remnants of formerly much more extensive forests, restricted due to land use change, woodcutting and grazing. These small-scale cultivations, generally including cereals, fruit orchards, grapes and vegetables, are common and scattered mostly in the western part of the Study Area. Such mosaic landscape occurs near the borders to Albania, on the hills surrounding the western parts of the Aliakmonas River valley and the northwestern foothills of Vermio.

Hill slopes surrounding cultivated valleys are often covered with very loose and impoverished shrubland. This is composed mainly of *Juniperus oxycedrus* or sometimes *J. oxycedrus* with *Paliurus spinos-christi* and scattered single oak (*Quercus* spp.) trees. A typical example of this hilly landscape is shown in *Figure 4-11*. 
Narrow valleys are formed along rivers and streams mainly in the western part of the Study Area (see Figure 4-12). Such examples are parts of the Aliakmonas River, which is the longest river in Greece. Inside the valleys and depending on their width agriculture and pasture land occurs. Riparian vegetation, consisting mainly of loose trees and shrubs such as Salix spp., Populus spp., Alnus glutinosa or Platanus orientalis, develops close to the river beds. Hills surrounding the valleys are of various inclinations and are covered by forest, shrubland, agricultural land or a mosaic of them.
Figure 4-12  Small Stream in a Narrow Valley

Mountain Forested Areas

Most mountain areas are located in the western part of the Study Area. The largest massifs are the mountains Vermio, Vourinos, Verno and Siniatsiko, which are entirely included in the Study Area. To the southeast the Pieria mountain range and to the north Paiko and Voras mountains are only marginally included.

Mountain areas with moderate to high inclinations and steep slopes are mostly covered by deciduous and evergreen forest (Figure 4-13). The commonest at elevations between ca. 600 and 800 m are oak and mixed deciduous forests, usually loose, turning to rather dense Fagus sylvatica and coniferous (mainly Pinus nigra) forests at elevations above ca. 800 m. Forest clearings are sometimes turned into cultivation and pasture land.

Mountain plateaus and areas above the timberline are covered with grasslands, meadows and pastures. Vegetation here is generally low, composed mostly of herbs and low-growing shrubs. Larger shrubs or trees
(e.g. *Crataegus orientalis*, *Rosa* spp., *Quercus* spp.) may occur but are scarce.

**Figure 4-13**  Coniferous forest on Mount Vermio (Xsirolivado)

### 4.4.7 Landscape Capacity

Landscape capacity refers to the degree to which a particular landscape is able to accommodate change without significant effects on its character, or overall change of landscape character type. Reaching conclusions about capacity means making a judgment about the amount of change of a particular type that can be accommodated without having unacceptable adverse effects on the character of the landscape, or the way that it is perceived, and without compromising the values attached to it.

Mosaic landscapes, or landscapes that are already affected by man-made features have a higher potential to absorb a change without losing their intrinsic character than uniform and remote ones. In this sense, the hilly agricultural areas in the Study Area which form a mosaic landscape of
agricultural land, forest and settlements have a higher capacity to absorb the visual impacts of pipeline construction.

On the contrary, mountainous forested areas constitute a rather uniform landscape and can be described as landscapes with character of high sensitivity, i.e. landscapes difficult to recuperate after loss. Mediterranean-type forests take a long time to mature and forest clearance due to the pipeline construction should be considered as a long-term effect, easily visible and perhaps difficult to mitigate.

Among the landscape types present in the Study Area, the large plains with agricultural land are the less sensitive to impact, i.e. they have the highest capacity to absorb visual impacts of pipeline construction. Once construction is finished, the former land use is re-established and only minor elements (pipeline markers) are visible.

4.4.8 Protected Areas

Table 4.8 lists the protected areas (Natura 2000 sites, protected areas under the Forest Law, National Parks, Ramsar sites and Wild Life Refuges) within vicinity of the Project Study Area. Map 2 (Annex I) presents protected areas within the Study Area.
### Table 4-8  Protected Areas within vicinity of the Project Study Area

<table>
<thead>
<tr>
<th>SITE</th>
<th>Natura 2000 code</th>
<th>Forest Law</th>
<th>Other major Environmental Protection Schemes</th>
<th>Size of Protected Area (max, approx) (ha)</th>
<th>Overlap with the Corridor</th>
<th>Crossings by the Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammos Mountain</td>
<td>SCI GR1320002</td>
<td>GG 656/B/1986[^1]</td>
<td></td>
<td>34,357</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Kastoria lake (Orestiada)</td>
<td>SCI GR1320001</td>
<td></td>
<td></td>
<td>4,732</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Verno Mountain (Vitsi)</td>
<td>SCI GR1340006</td>
<td></td>
<td></td>
<td>8,202</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Chimaditida and Zazari lakes</td>
<td>SCI GR1340005, SPA GR1340008</td>
<td></td>
<td></td>
<td>5,193</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>North Vourinos Mountain &amp; Mellia</td>
<td>SPA GR1330002</td>
<td></td>
<td></td>
<td>17,855</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Vourinos Mountain (Asprovouni)</td>
<td>SCI GR1330001</td>
<td></td>
<td></td>
<td>764</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Vegoritis – Petron lakes</td>
<td>SCI GR1340004, SPA GR1340007</td>
<td></td>
<td></td>
<td>12,569</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

[^1]: Grammos mixed forest  
[^2]: declared as "National Woodland park"
<table>
<thead>
<tr>
<th>SITE</th>
<th>Natura 2000 code</th>
<th>Forest Law</th>
<th>Other major Environmental Protection Schemes</th>
<th>Size of Protected Area (max, approx) (ha)</th>
<th>Overlap with the Corridor</th>
<th>Crossings by the Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Agra</td>
<td>SCI GR1240004</td>
<td></td>
<td></td>
<td>1,249</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Stena Apsalou - Moglenitsa</td>
<td>SCI GR1240005&lt;br&gt;SPA GR1240009</td>
<td></td>
<td></td>
<td>6,110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paiko Mountain</td>
<td>SCI GR1240003&lt;br&gt;SPA GR1240009</td>
<td></td>
<td></td>
<td>91,968 (incl. Stena Apsalou – Moglenitsa)</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Axios – Aliakmonas – Loudias delta – Alki Kitrous and surrounding area[^3]</td>
<td>SCI GR1220002&lt;br&gt;SPA GR1220010</td>
<td>Ramsar site (GG 350/T.A./20-11-1974, GG 84/A/31-5-91)&lt;br&gt;National Park (GG ΑΠΠ220/ 14 May 2009)</td>
<td></td>
<td>33,682 SCI area</td>
<td>yes</td>
<td>The route crosses the Natura 2000 site but lies outside the border of the National Park</td>
</tr>
<tr>
<td>Stena Aliakmona</td>
<td>SCI GR1210002</td>
<td></td>
<td></td>
<td>3,623</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Pieria Mountain</td>
<td>SCI GR1250002</td>
<td></td>
<td></td>
<td>16,640</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Voras Mountain</td>
<td>SPA GR1240008</td>
<td></td>
<td></td>
<td>79,453</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Anthofo</td>
<td>SPA GR1230006</td>
<td></td>
<td></td>
<td>3309</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Vermio Mountain</td>
<td>SCI</td>
<td></td>
<td></td>
<td>255,555</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

[^3] Including river Axios
<table>
<thead>
<tr>
<th>SITE</th>
<th>Natura 2000 code</th>
<th>Forest Law</th>
<th>Other major Environmental Protection Schemes</th>
<th>Size of Protected Area (max, approx) (ha)</th>
<th>Overlap with the Corridor</th>
<th>Crossings by the Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Tripotamos</td>
<td>GG 215/Δ 12-03-03(^{[4]})</td>
<td>no</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Town of Naoussa</td>
<td>GG 428/Δ 28-05-02(^{[5]})</td>
<td>no</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Platanus orientalis</em> trees</td>
<td>GG 590/B/1977</td>
<td>no</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flamouria Grammatiko on Vermio Mountain (Livaditsi – Tovaritsi)</td>
<td>Wild Life Refuge (GG 592/21-5-01)</td>
<td>7,968</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kouri in Eordea plateau</td>
<td>Wild Life Refuge (GG 769/12-6-76)</td>
<td>17,487</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{[4]}\) designated landscape areas  
\(^{[5]}\) designated landscape areas
An overview of the only protected site where there is overlap with the Project Study Area is presented below.

**Axios – Loudias - Aliakmonas Estuaries National Park**

The Axios – Loudias - Aliakmonas estuaries National Park has been recognised as a wetland of major ornithological interest since the beginning of the ’70s when it was declared a Ramsar site. Breeding species of conservation interest include: *Phalacrocorax pygmeus*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardea ralloides*, *Egretta garzetta*, *Ardea purpurea*, *Platalea leucorodia*, *Tadorna tadorna*, *Haematopus ostralegus*, *Himantopus himantopus*, *Recurvirostra avosetta*, *Glareola pratincola*, *Charadrius alexandrinus*, *Larus melanocephalus*, *Stern albitrons*, *St. hirundo* and *Calandrella brachydactyla*.

In addition, the area hosts significant numbers of threatened and rare bird species while wintering and migrating. Parts of the delta and the rivers, as well as sea water until 6 m depth serve as spawning ground for fish populations of Thermaikos gulf and N. Aegean Sea. The area hosts at least two mammal species (*Spermophilus citellus*, *Lutra lutra*) and several reptile species protected according to Directive 92/43 EEC. *Lycaena dispar* (a butterfly species protected according to Directive 92/43 EEC) is also known from the wet lowlands. The area comprises extensive reedbeds, rice fields, lagoons and canals. For most species the vital habitats are concentrated on the delta zone fringing the coast that is the part enclaved by the “strict nature reserve”

The National Park is divided into three sub-zones of management: (i) Strict Nature Reserve, (ii) Nature Reserves and (iii) Cultivations. The coverage of these management sub-zones is given in Table 4.9.

---

1 *Pr* else, “absolute nature reserve area”
Table 4-9 Management Zones within the Axios – Loudias - Aliakmonas estuaries National Park

<table>
<thead>
<tr>
<th>Zone type</th>
<th>Area (ha, approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strict nature reserve</td>
<td>3549</td>
</tr>
<tr>
<td>Nature reserves</td>
<td>14664</td>
</tr>
<tr>
<td>Cultivations</td>
<td>13744</td>
</tr>
</tbody>
</table>

The 2 km corridor (but not the working strip) of the Base Case cuts through the northernmost segment of an area identified as a nature reserve extending along River Axios. However, the working strip where the Project is going to be developed has been created as such in order to avoid the boundaries of the National Park (see Figure 4-14).
Figure 4-14  Protected Areas in the vicinity of the Axios River crossing

(Left: National Park and Ramsar site. Right: Natura 2000)

4.4.9  Areas of Conservation Interest

*Important Bird Areas*

Important Bird Areas (IBAs) are key sites for conservation and are often part of a protected-area network. They bear one (or more) of the three following characteristics:

- Hold significant numbers of one or more globally threatened species;
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species; and/or
- Have exceptionally large numbers of migratory or congregatory species.
All IBAs within the Study Area comprise part of the Natura 2000 network, therefore being already under a particular protection status. The species – criteria which indicate the conservation interest for these sites are shown in the following table. The distribution of IBAs in relationship to the Study Area can be seen in Figure 4-15.

### Table 4-10  IBAs and Species-Criteria within vicinity of the Project Route

<table>
<thead>
<tr>
<th>Code</th>
<th>IBA name</th>
<th>Species - criteria</th>
<th>Status</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR025</td>
<td>River Axios</td>
<td>Phalacrocorax pygmeus</td>
<td>W</td>
<td>&gt;5,000</td>
</tr>
<tr>
<td>GR028</td>
<td>Axios, Loudias and Aliakmon rivers’ deltas</td>
<td>Limosa limosa</td>
<td>MP</td>
<td>100-4,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Numenius tenuirostris</td>
<td>MP</td>
<td>&gt;1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Haematopus ostralegus</td>
<td>R</td>
<td>5-15 pairs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Himantopus himantopus</td>
<td>SV</td>
<td>100-150 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recurvirostra avocetta</td>
<td>R</td>
<td>50-70 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charadrius alexandrinus</td>
<td>R</td>
<td>50-100 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glareola pratincola</td>
<td>SV</td>
<td>50-100 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Larus cachinnans</td>
<td>W</td>
<td>&lt;5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Larus melanocephalus</td>
<td>SV</td>
<td>800-1,400 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterna albifrons</td>
<td>SV</td>
<td>70-130 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phalacrocorax pygmeus</td>
<td>W</td>
<td>&gt;5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Egretta garzetta</td>
<td>R</td>
<td>274-700 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ardeola ralloides</td>
<td>SV</td>
<td>150-300 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nycticorax nycticorax</td>
<td>SV</td>
<td>420-800 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ixobrychus minutus</td>
<td>SV</td>
<td>30-80 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Platalea leucorodia</td>
<td>R</td>
<td>16-50 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pelecanus crispus</td>
<td>MP</td>
<td>5-50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calandrella brachydactyla</td>
<td>SV</td>
<td>Frequent</td>
</tr>
<tr>
<td>GR045</td>
<td>Lakes Petron</td>
<td>Phalacrocorax pygmeus</td>
<td>R</td>
<td>3-10 p</td>
</tr>
<tr>
<td>GR046</td>
<td>Lakes Zazari</td>
<td>Phalacrocorax pygmeus</td>
<td>R</td>
<td>13-20 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tachybaptus ruficollis</td>
<td>R</td>
<td>34-40 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Podiceps cristatus</td>
<td>R</td>
<td>34-40 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anas crecca</td>
<td>R</td>
<td>2-5 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anas platyrhynchos</td>
<td>R</td>
<td>15-20 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aythya ferina</td>
<td>R</td>
<td>20-25 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aythya nyroca</td>
<td>SV</td>
<td>15-20 p</td>
</tr>
</tbody>
</table>

---

1 all according to year 2000 except Mountain Vourinos (year 2005)
2 R: resident, MP: migrant passage, W: wintering, SV: summer visitor
<table>
<thead>
<tr>
<th>Code</th>
<th>IBA name</th>
<th>Species - criteria</th>
<th>Status</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Circus aeruginosus</td>
<td>SV</td>
<td>3-4 females</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Circus pygargus</td>
<td>SV</td>
<td>&gt;2 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aquila chrysaetos</td>
<td>R</td>
<td>1 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Merops apiaster</td>
<td>SV</td>
<td>15-20 p</td>
</tr>
<tr>
<td>GR048</td>
<td>Lake Kastoria</td>
<td>Aythya nyroca</td>
<td>SV</td>
<td>&lt;30 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mergus merganser</td>
<td>W</td>
<td>5-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phalacrocorax pygmeus</td>
<td>W</td>
<td>&lt;500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ardeola ralloides</td>
<td>SV</td>
<td>10-50 p</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pelecanus crispus</td>
<td>MP</td>
<td>50-100</td>
</tr>
<tr>
<td>GR051</td>
<td>Mount Vourinos</td>
<td>Falco biarmicus</td>
<td>R</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aquila heliaca</td>
<td>R</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Figure 4-15  Distribution of Important Bird Areas (IBAs) along the Project Route
CORINE Sites

The CORINE Biotopes are particular areas that have been identified as "major nature sites" across Europe by the European Environment Agency (EEA) and include sensitive or rare habitats, vulnerable ecosystems and species of importance. In the European context, the CORINE Biotope Sites (and in general CORINE programs) would be one of the criteria for the studies towards the selection and establishment of protected areas: indeed, several CORINE sites have been incorporated in the Natura 2000 network currently operating within the EU. It should be emphasized that CORINE Biotopes do not have a protection status themselves, but only constitute areas of conservation interest.

All CORINE areas within proximity to the Study Area have been either incorporated in the Natura 2000 network or lie outside the 2 km corridor.

Other sites of Conservation Interest (FILOTIS database, Habitats - Landscapes of Aesthetic Value)

One FILOTIS site (in addition to those included into the Natura 2000 network) can be found within the Study Area:

AT4011023 – Lehovo, Kleisoura, Variko. The site comprises a montane valley with extended deciduous forest. Lehovo, Kleisoura and Variko are historic settlements within the valley and along the hills and mountains of the area. It is crossed by the proposed route.

Wildlife Refuges

The following wildlife refuges can be found within the Study Area:

- Flamouria – Grammatiko on Vermio Mountain (GG 592 /21-5-01)\(^1\); and
- Kouri in Eordea plateau (GG 769/12-6-76).

\(^1\) also known as Livaditsi – Tovaritsi
4.4.10 Environmental Indicators

Table 4.11 presents the environmental indicators for the Study Area. As explained in Section 4.3.4, although indicative and preliminary in nature, these provide a good understanding of the specific environmental baseline characteristics of the Study Area, and more specifically of the Pipeline Protection Strip (PPS) (8 metres wide strip, i.e. 4 m either side of the proposed centreline) and the Working Strip (40 m wide strip). The indicators values for the safety zone of and the construction corridor provide an indication of the baseline characteristics of the areas directly affected by the pipeline construction and operation.

**Table 4-11 Environmental Indicators of the Route**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value (approximate figures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length of the route</td>
<td>181 km</td>
</tr>
<tr>
<td>Total length and surface clearance within Protected Areas (excluding Natura 2000 sites)</td>
<td>0 km/ha</td>
</tr>
<tr>
<td>Length within Important Bird Areas (IBA)</td>
<td>1.5 Km</td>
</tr>
<tr>
<td>Total length and surface clearance within Natura 2000 Network</td>
<td>1.5 km, 5.7 ha</td>
</tr>
<tr>
<td>Total area of non-urbanised and non-agricultural land crossed</td>
<td>151 ha</td>
</tr>
<tr>
<td>Total area of non-urbanised and non-agricultural land crossed within the PPS (8 metres width)</td>
<td>30 ha</td>
</tr>
<tr>
<td>Total forest clearance (construction corridor 40 metres width)</td>
<td>92 ha</td>
</tr>
<tr>
<td>Total forest permanent clearance within the PPS (8 metres width)</td>
<td>18 ha</td>
</tr>
<tr>
<td>Total broadleaved forest dominated by <em>Fagus, Quercus</em> and <em>Castanea</em> species to be cleared (construction corridor 40 metres width)</td>
<td>76 ha</td>
</tr>
<tr>
<td>Total broadleaved forest dominated by <em>Fagus, Quercus</em> and <em>Castanea</em> species to be cleared permanently within the PPS (8 metres width)</td>
<td>15 ha</td>
</tr>
<tr>
<td>Beech dominated forests (<em>Fagus sylvatica</em>) clearance (construction corridor 40 metres width)</td>
<td>23 ha</td>
</tr>
<tr>
<td>Beech dominated forests (<em>Fagus sylvatica</em>) to be cleared permanently within the PPS (8 metres width)</td>
<td>4.5 ha</td>
</tr>
<tr>
<td>Oak dominated forests (<em>Quercus</em> spp.) clearance (construction corridor 40 metres width)</td>
<td>53 ha</td>
</tr>
<tr>
<td>Oak dominated forests (<em>Quercus</em> spp.) to be permanently cleared within the PPS (8 metres width)</td>
<td>11 ha</td>
</tr>
<tr>
<td>Indicator</td>
<td>Value (approximate figures)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Chestnut dominated forests (Castanea sativa.) clearance (construction corridor 40 metres)</td>
<td>0 ha</td>
</tr>
<tr>
<td>Chestnut dominated forests (Castanea sativa) to be permanently cleared within the PPS (8 metres width)</td>
<td>0 ha</td>
</tr>
<tr>
<td>Area of coniferous forests to be cleared **</td>
<td>2.5 ha</td>
</tr>
<tr>
<td>Area of coniferous forests to be permanently cleared in safety zone (8 metres width) **</td>
<td>0.5 ha</td>
</tr>
<tr>
<td>Area of montane and subalpine grasslands, meadows and pastures to be cleared</td>
<td>25 ha</td>
</tr>
<tr>
<td>Total area of agricultural lands and plantations to be cleared</td>
<td>570 ha</td>
</tr>
<tr>
<td>Area covered by brown bear range crossed (area where the species is constantly present)</td>
<td>2500 ha</td>
</tr>
<tr>
<td>Area covered by brown bear range crossed (area which the species has recolonised)</td>
<td>16700 ha</td>
</tr>
<tr>
<td>Total area of ‘wetland’ type habitats (standing water, lagoons, running waters incl. river crossings, saltmarshes…) **</td>
<td>3 ha</td>
</tr>
<tr>
<td>Total number of river crossings in rivers of perennial flow ***</td>
<td>30</td>
</tr>
<tr>
<td>slope degree &lt;33° in working strip</td>
<td>720 ha</td>
</tr>
<tr>
<td>Area of serpentine soils to be cleared</td>
<td>10 ha</td>
</tr>
</tbody>
</table>

* Pinus nigra and / or Pinus sylvestris pure or mixed forest. It does not include afforestations.

** The calculation on the wetlands has to be taken as an indication in view of the uncertainty due to the scale of the cartography (GIS layers)

*** Data on the hydrological status (perennial or seasonal) of the rivers are according to the Hellenic Military Geographical Service (HMG5). Water bodies east of Veroia (east of river Potamos), and west of river Axios are not taken into account because the vast majority comprises channelized streams and/or irrigation works.
4.5 PHYSICAL ENVIRONMENT

4.5.1 Introduction

The route crosses a variety of different bedrock units and overlying soft rock deposits. In summary, these units comprise:

- Holocene soft rocks, mainly at the eastern section, Thessaloniki - Giannitsa Plain;
- Cretaceous Flysch-dominated bedrock sequences, Ophiolithes and carbonate-dominated bedrock units and Cretaceous and Triassic-Jurassic carbonates, mostly marbles, at the Vermio mountains;
- Holocene and Tertiary soft rocks of the Ptolemais basin;
- Crystalline schists, multifolded and microfolded schist series of the Pelagonian Basement (Paleozoic) Mount Askion Pass - plains of Kastoria lake;
- Old quaternary fluvial terraces and fluvial and lacustrine terrace deposits of Quaternary (Pliocene-Pleistocene) age - Aliakmon River - terraces and recent floodplains; and
- Mostly marls, sandstone and clastic limestones of tertiary age (Molasse Zone) at the mountainous Greek/Albania border region.

4.5.2 Geological Formations along the Route

Thessaloniki- Giannitsa Plain

The proposed Project route crosses flat or slightly undulating terrain and one small hill to the south of Skydra city. No rugged, dissected landforms have to be traversed by the route within this section.

Vermio Mountain Pass

The landform of this mountain range is characterised by predominantly wide stretched crests draft and ridges. At some locations gorges and scars exist. The maximum elevation along the route is approximately 1140 m, north of Ano Grammatiko. The flanks of the locally forested risings are predominately moderately steep. Some steep slopes exist along the banks of the brooks, creeks and torrents which dissect the flanks of diverse crests and ridges.
Eastern margin of the Fiorina-Vegoritis-Ptolemais Basin

In this segment the Project route crosses a pediment plain consisting of minor rises and depressions. The depressions were formed by tectonic processes and are usually filled with scree and debris. At the flanks of the rises exist sometimes terrace like features which are made up of fine grained loose alluvial deposits and debris.

Ptolemais Basin

This flat basin terrain has a very uniform geomorphological character. The geology is predominately made up of young sedimentary deposits. North-west of Ptolemaida a ridge with an elevation up to 720 m divides the flat basin terrain.

Mount Askion Pass - plains of Kastoria lake

Ascending from the plains of Ptolemeida basin the route reaches its highest elevation of Mount Askion north of Kleisoura with a maximum elevation of 1215 m asl. The characteristic morphology is characterised by smooth mountain ridges with incision of small creeks with fillings of scree and talus cones beside them. At the foot of Mount Korissos (~km 138.0 - ~km 140.3) this length of the Project route runs on gently inclined terraces dissected by several incised gullies. Moreover stream beds and on the almost flat outer fringe of an old, residual talus cone will be passed. At some locations old, erosive stream/torrent cliffs with a maximum height of >10 m were observed. After descending through a braided valley system west of Kleisoura the route reaches the flat basin planes east of Kastoria Lake, where almost flat terrain underlain by alluvial sediments is predominant. Occasionally the area is characterised by terrace deposits.

Aliakmon River - terraces and recent Floodplain

The elevation of the Aliakmonas River terrace is up to 20 m higher in altitude than the lakeside of Lake Kastoria and the contiguous alluvial plain. The contemporary Aliakmonas floodplain lies approximately 20 m below the edge of the terrace. At the boundary in between the terraces and the incised alluvial plain/recent floodplain occur steep cliffs/scarp with an inclination of up to ~35°. The cliff sections observed during the site visits did not feature any apparent instability. The top of the terrace is almost flat with a slight undulation.
The terrain is predominately made up of gentle hills and ridges featuring wide crests. Most of the terrain crossed by the Project lies below 1000 m a.s.l.

4.5.3 Seismicity of the Study Area

The available literature pertaining to historical seismic activity in western Macedonia, (memoirs, historical records, research papers, historical earthquake catalogues), is rather poor. This should be attributed to a combination of a grossly incomplete record and relatively low seismic activity. The data on earthquake activity is almost non-existent for BCE\(^1\) times, lost together with the detailed record of the era. Sparse historical accounts and archaeological evidence shows that a number of earthquakes have inflicted severe damage on ancient cities. For instance, the tilted or and collapsed walls at the Acropolis of Aiani (approximately 40 km WSW of Kozani) are attributed to earthquake activity. It is also known that the city of Pella, the capital of the ancient kingdom of Macedonia, was levelled by an earthquake some time during the 1\(^{st}\) decade of the 1\(^{st}\) century BCE; the damage was so severe, that the city was relocated.

Nevertheless, there is no hard evidence to assess the origin and size of the events that caused these disasters; one can only speculate that they have been produced by now known active faults in their vicinity. The record is slightly better during the Byzantine and Ottoman eras, with a small number of events recorded in monastery logs and personal memoirs. Still, the Ottoman era record is quite incomplete because most of the official documents were withdrawn together with the Ottoman rule and are still accessible in present-day Turkey. A fairly complete record of large earthquakes exists for the most part of the 19\(^{th}\) century.

Table 4.12 contains a list of all known major historical earthquakes that have occurred within the broader area of the TAP route, i.e. within a rectangle with geodetic coordinates (20.0E 39.6N) and (24.0E, 41.4N). The table lists date of occurrence, the macroseismic epicentral coordinates, the macroseismic magnitude, the maximum (meizoseismal) intensity and the area where the maximum intensity was observed.

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\(^1\) Before Common Era
### Table 4-12 Major Historical Earthquakes that have occurred within or in Proximity of the Study Area

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Day</th>
<th>Hour</th>
<th>Lat N</th>
<th>Lon E</th>
<th>M</th>
<th>I</th>
<th>Meizoseismal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>-95 BCE</td>
<td>-40.8</td>
<td>-22.6</td>
<td>&gt;6</td>
<td>&gt;8</td>
<td>Pella</td>
<td></td>
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<tr>
<td>620</td>
<td>40.7</td>
<td>23.2</td>
<td>7</td>
<td>VII</td>
<td>Thessaloniki</td>
<td></td>
<td></td>
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<tr>
<td>677</td>
<td>40.7</td>
<td>23.2</td>
<td>6.5</td>
<td>VII</td>
<td>Thessaloniki</td>
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<td></td>
</tr>
<tr>
<td>700</td>
<td>40.7</td>
<td>23.1</td>
<td>6.6</td>
<td>VII</td>
<td>Thessaloniki</td>
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<td></td>
</tr>
<tr>
<td>896</td>
<td>40.5</td>
<td>22.2</td>
<td>6.0</td>
<td>VIII</td>
<td>Veroia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1211</td>
<td>40.4</td>
<td>22.1</td>
<td>6.5</td>
<td>VIII</td>
<td>Veroia</td>
<td></td>
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<tr>
<td>1395</td>
<td>40.92</td>
<td>22.34</td>
<td>6.7</td>
<td>VIII</td>
<td>Edessa</td>
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<tr>
<td>1420</td>
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<tr>
<td>1665</td>
<td>39.6</td>
<td>21.6</td>
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<td>1698</td>
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<td>VII</td>
<td>Meteor</td>
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<td>6.4</td>
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<td>1709</td>
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<td>Kozani</td>
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<td>6.3</td>
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<td>Elassona</td>
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<td>VIII</td>
<td>Koinispolis (Epirus)</td>
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<td>1812</td>
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<td>Kastoria</td>
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<tr>
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<td>Delvinio (Albania)</td>
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<td>VIII</td>
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<tr>
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<td>6.3</td>
<td>IX</td>
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<td>VIII</td>
<td>Ioannina (Epirus)</td>
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<td>VIII</td>
<td>Ioannina</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Day</td>
<td>Hour</td>
<td>Lat N</td>
<td>Lon E</td>
<td>M</td>
<td>I</td>
<td>Meizoseismal Area</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>1902</td>
<td>7</td>
<td>5</td>
<td>14:56</td>
<td>40.82</td>
<td>23.04</td>
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<td>4</td>
<td>4</td>
<td>41.8</td>
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<td>7.3</td>
<td>X</td>
<td>Kresna (Bulgaria)</td>
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<td>1</td>
<td>20</td>
<td>02:30</td>
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<td>22.93</td>
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<td>X</td>
<td>Skiti (Magnesia)</td>
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<td>28</td>
<td>40.9</td>
<td>20.7</td>
<td>6.0</td>
<td>VII</td>
<td>Starovo (Ochris)</td>
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</tr>
<tr>
<td>1911</td>
<td>2</td>
<td>18</td>
<td>21:35</td>
<td>40.9</td>
<td>20.7</td>
<td>6.7</td>
<td>IX</td>
<td>Ochris</td>
</tr>
</tbody>
</table>

The events of Table 4.12 are also presented in Figure 4-16. It must be emphasized that many of the listed events could not have inflicted appreciable damage on structures along the Project route.

**Figure 4-16** Macroseismic Epicenters and Magnitudes of Historical Earthquakes in or within proximity to the Study Area
4.5.4 Tectonic Faults along the Route

There are of 43 known or assumed faults along the Project route, the majority on the eastern and western sections.

### Table 4-13 Tectonic Faults within or in proximity of the Study Area

<table>
<thead>
<tr>
<th>Km</th>
<th>Class</th>
<th>Fault Strike</th>
<th>Fault age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thessaloniki- Giannitsa Plain</td>
</tr>
<tr>
<td>2.9</td>
<td>4</td>
<td>N45°E</td>
<td>Pliocene- Pleistocene</td>
</tr>
<tr>
<td>6.2</td>
<td>4</td>
<td>N90°E</td>
<td>Pliocene- Pleistocene</td>
</tr>
<tr>
<td>7.9</td>
<td>4</td>
<td>N90°E</td>
<td>Pliocene- Pleistocene</td>
</tr>
<tr>
<td>9.5</td>
<td>4</td>
<td>N45°W</td>
<td>Quaternary</td>
</tr>
<tr>
<td>35.6</td>
<td>2</td>
<td></td>
<td>This ~50km long neo-tectonic structure is the longest individual active fault crossed by the TAP and compatible with a per-event displacement in excess of 1m. The existence of this inferred fault can neither be verified nor rejected as it exhibits no significant morphological or other characteristics which make it clearly identifiable.</td>
</tr>
<tr>
<td>58.9</td>
<td>4</td>
<td>N25°E</td>
<td>Pliocene – Lower Pleistocene</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vermio Mountain Pass</td>
</tr>
<tr>
<td>68.1</td>
<td>4</td>
<td>N35°E</td>
<td>Pliocene</td>
</tr>
<tr>
<td>69.5</td>
<td>4</td>
<td>N35°W</td>
<td>Pliocene - Early Quaternary</td>
</tr>
<tr>
<td>82.8</td>
<td>4</td>
<td>N40°E</td>
<td>Pliocene - Early Quaternary</td>
</tr>
<tr>
<td>83.2</td>
<td>4</td>
<td>N05°E</td>
<td>Pliocene - Early Quaternary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eastern margin of the Fiorina-Vegoritis -Ptolemais basin</td>
</tr>
<tr>
<td>85.3</td>
<td>4</td>
<td>N50°W</td>
<td>Quaternary</td>
</tr>
<tr>
<td>85.5</td>
<td>4</td>
<td>N40°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td>86.5</td>
<td>4</td>
<td>N25°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td>88.3</td>
<td>2</td>
<td>N40°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td>90.</td>
<td>1</td>
<td>N30°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td>93.6</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>96.1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97.7</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>107.4</td>
<td>1</td>
<td>N165°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td>107.42</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ptolemais basin</td>
</tr>
<tr>
<td>111</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111.4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113.2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113.9</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>114.7</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>122.5</td>
<td>1</td>
<td>N210°E</td>
<td>Quaternary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mount Askion Pass - plains of Kastoria lake</td>
</tr>
<tr>
<td>131.5</td>
<td>1</td>
<td>N45°E</td>
<td>Quaternary</td>
</tr>
</tbody>
</table>
### 4.5.5 Hydrographic Network / Hydrology

The Project route crosses two main rivers - Axios and Aliakmonas. The crossing point of Axios River is west of the settlement at Gefura and Aliakmonas River will be crossed west of Hiliodendo and north of Argos Orestiko. Other important river crossings along the Project route are Loudias and Potamos, Lianorrema and Grammatiko rivers.

**Hydrological Features of Axios and Aliakmonas Rivers**

Axios, located in the central Balkan Peninsula, drains the second largest catchment in the Balkans. The river drains 83% of FYR Macedonia and small parts of Bulgaria, Serbia and Greece before it enters the Aegean Sea (Thermaikos Gulf). Major tributaries are the Crna (5890 km²) and the Brejalinica (4307 km²). The river is hydrologically connected to Lake Doirani (Dojran), shared between Greece and FYR Macedonia. Axios still exhibits a near-natural flow regime. Highest flow occurs in April and minimum in August. Rain and snow contribute 53% and 30%, respectively, to total flow.

Aliakmonas, the longest river in Greece, receives overflow waters from Lake Kastoria. Its main upstream tributary is the Venetikos (821 km²). Downstream, the tributaries Almopeos and Edesseos, connected through a long irrigation canal (2100 km²), join the river that finally discharges into the Thermaikos Gulf forming a joint delta with Axios. In the free-flowing upper Aliakmonas, the ratio
between monthly maximum (March) and minimum (August–September) discharge is one of the highest in the Balkans. About 70% of the river is hydrologically heavily modified due to damming. Reservoirs (Polyfyto, Sfikia and Asomata) cover 81 km² and can store 2.9 km³. Downstream of reservoirs, maximum discharge occurs in summer and minimum in spring. The shallow karstic Kastoria Lake (28 km², mean depth: 4.4 m) overflows in Aliakmonas through a ditch.

Historical discharge statistics from the Axios and Aliakmonas rivers are given in Table 4.14.

Table 4-14  Discharge Characteristics of Axios and Aliakmonas Rivers

<table>
<thead>
<tr>
<th>River</th>
<th>Station</th>
<th>Period</th>
<th>A (km²)</th>
<th>NQ</th>
<th>MNQ</th>
<th>MQ</th>
<th>MHQ</th>
<th>HQ</th>
<th>MHQ/M NQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axios</td>
<td>Skopje</td>
<td>1978–1990</td>
<td>4650</td>
<td>6.6</td>
<td>24.3</td>
<td>57.3</td>
<td>102</td>
<td>164</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Axioupoli</td>
<td>1961–2000</td>
<td>20200</td>
<td>3.4</td>
<td>29.7</td>
<td>115</td>
<td>275</td>
<td>949</td>
<td>9.2</td>
</tr>
<tr>
<td>Aliakmonas</td>
<td>Ilarion</td>
<td>1962–1988</td>
<td>5505</td>
<td>2.1</td>
<td>4.57</td>
<td>48.3</td>
<td>138</td>
<td>369</td>
<td>30.1</td>
</tr>
<tr>
<td></td>
<td>Polyfyto</td>
<td>1975–2006</td>
<td>5800</td>
<td>0</td>
<td>10.9</td>
<td>43.8</td>
<td>88.8</td>
<td>196</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>Sfikia</td>
<td>1986–2006</td>
<td>6030</td>
<td>15</td>
<td>59.5</td>
<td>80.8</td>
<td>125</td>
<td>196</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Asomata</td>
<td>1986–2006</td>
<td>6180</td>
<td>0</td>
<td>8.6</td>
<td>58</td>
<td>89.6</td>
<td>191</td>
<td>10.4</td>
</tr>
</tbody>
</table>

[NB All discharge values are in m³/s]

A: catchment area upstream of gauging station, NQ: lowest measured mean monthly discharge, MNQ: arithmetic mean of the lowest measured mean monthly discharge, MQ: arithmetic mean annual discharge, MHQ: arithmetic mean annual of highest mean monthly discharge, HQ: highest measured mean monthly discharge, * arithmetic mean of month with minimum/maximum discharge, MAX/MIN: ratio between the month with maximum discharge and the month with minimum discharge, PPC: Public Power Corporation, HMRDF: Hellenic Ministry of Rural Development and Food.
Apart from Axios, Aliakmonas and Loudias, a number of smaller watercourses will also cross the Project route. It is estimated that a total of 31 perennial river crossings will be required.

4.6 CLIMATE AND METEOROLOGICAL CONDITIONS

4.6.1 Central Macedonia Region

Climate in Central Macedonia Region is characterised by a variety of climates, such as Mediterranean climate in the area of Halkidiki, while in the inland and the mountain areas with high altitude the climate is mainly continental.

Average annual precipitation ranges from 400 up to 800 mm, while in the mountainous parts exceeds to 1000 mm. The snow is quite common during the period September April.

Highest temperatures are recorded during August while January is the coldest month of the year, with an average temperature of 4.6°C. June and July have the lowest humidity (%) and rainfall while December has the highest humidity (78.2%) and rainfall (69.1mm). Average annual wind speed in the area is 3 knots (kt) or 1.54 m/s while in May average wind speed may reach 4.7kt or 2.4 m/s. ¹

Figure 4-17 to

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¹ 1 kt = 0.51 m/s = 1.85 km/h
Figure 4-20 present monthly minimum, maximum and average values for temperature, humidity, rainfall, and wind speed for the broader Central Macedonia Region.

Figure 4-17 Temperature (°C) in the Study Area, Central Macedonia Region (Trikala Imathia station, National Meteorological Service)

<table>
<thead>
<tr>
<th></th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Min Temperature</td>
<td>0.6</td>
<td>1.4</td>
<td>4.4</td>
<td>8.2</td>
<td>12.8</td>
<td>16.3</td>
</tr>
<tr>
<td>Monthly Average Temperature</td>
<td>4.6</td>
<td>5.9</td>
<td>9.4</td>
<td>14.1</td>
<td>19.6</td>
<td>24.1</td>
</tr>
<tr>
<td>Monthly Max Temperature</td>
<td>9.1</td>
<td>10.8</td>
<td>14.5</td>
<td>19.4</td>
<td>25.1</td>
<td>29.5</td>
</tr>
<tr>
<td><strong>2nd Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Min Temperature</td>
<td>18.0</td>
<td>17.3</td>
<td>14.1</td>
<td>9.9</td>
<td>5.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Monthly Average Temperature</td>
<td>25.7</td>
<td>24.7</td>
<td>21.1</td>
<td>15.6</td>
<td>9.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Monthly Max Temperature</td>
<td>31.3</td>
<td>30.9</td>
<td>27.8</td>
<td>21.6</td>
<td>14.3</td>
<td>10.1</td>
</tr>
</tbody>
</table>
Figure 4-18  Humidity (%) in the Study Area, Central Macedonia Region (Trikala Imathia station, National Meteorological Service)

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Humidity Average</td>
<td>76.4</td>
<td>73.0</td>
<td>73.2</td>
<td>68.3</td>
<td>64.2</td>
<td>57.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Semester</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Humidity Average</td>
<td>57.5</td>
<td>62.8</td>
<td>66.8</td>
<td>73.1</td>
<td>77.1</td>
<td>78.2</td>
</tr>
</tbody>
</table>
Figure 4-19  Rain in the Study Area, Central Macedonia Region (Trikala Imathia station, National Meteorological Service)

<table>
<thead>
<tr>
<th></th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Rainfall Average</td>
<td>44.5</td>
<td>49.0</td>
<td>56.4</td>
<td>45.0</td>
<td>42.0</td>
<td>29.7</td>
</tr>
<tr>
<td>Total of Rain days</td>
<td>8.2</td>
<td>9.1</td>
<td>9.5</td>
<td>8.6</td>
<td>8.6</td>
<td>5.1</td>
</tr>
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</table>

<table>
<thead>
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<th>AUG</th>
<th>SEP</th>
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<tbody>
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<td><strong>2nd Semester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Rainfall Average</td>
<td>14.1</td>
<td>16.2</td>
<td>16.1</td>
<td>55.7</td>
<td>68.1</td>
<td>69.1</td>
</tr>
<tr>
<td>Total days of Rain</td>
<td>3.9</td>
<td>3.5</td>
<td>3.6</td>
<td>7.5</td>
<td>9.9</td>
<td>9.2</td>
</tr>
</tbody>
</table>
Figure 4-20  Wind speed (Kt) in the Study Area, Central Macedonia Region (Trikala Imathia station, National Meteorological Service)

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Wind Direction</td>
<td>NW</td>
<td>NW</td>
<td>NW</td>
<td>SE</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>Monthly Wind Speed</td>
<td>2.7</td>
<td>3.1</td>
<td>3.5</td>
<td>4.4</td>
<td>4.7</td>
<td>4.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>2nd Semester</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Wind Direction</td>
<td>SE</td>
<td>SE</td>
<td>SE</td>
<td>NW</td>
<td>NW</td>
<td>NW</td>
</tr>
<tr>
<td>Monthly Wind Speed</td>
<td>3.4</td>
<td>3.2</td>
<td>3.3</td>
<td>2.6</td>
<td>2.1</td>
<td>2.3</td>
</tr>
</tbody>
</table>

4.6.2 West Macedonia Region

Most of the West Macedonia Region is characterised by a continental climate, while the mountainous areas have a highland climate. Location and topography of the region contribute to the varying climate. Average annual precipitation ranges from 600 to 1000 mm and in the mountainous areas exceed 1200 mm. Snow is quite common for the area during September-April period. Average annual temperature ranges between 14.5 and 17 C° the coldest month being January and warmest in July.
Figure 4-21 to Figure 4-24 present monthly minimum, maximum and average values for temperature, humidity, rainfall, and wind speed for the broader West Macedonia Region Study Area.

**Figure 4-21** Temperature (°C) in the Study Area in West Macedonia Region (Kozani station, National Meteorological Service)

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Min Temperature</td>
<td>-1.2</td>
<td>0.5</td>
<td>1.8</td>
<td>5.2</td>
<td>9.5</td>
<td>13.2</td>
</tr>
<tr>
<td>Monthly Average Temperature</td>
<td>2.3</td>
<td>3.7</td>
<td>6.9</td>
<td>11.6</td>
<td>16.8</td>
<td>21.5</td>
</tr>
<tr>
<td>Monthly Max Temperature</td>
<td>6.1</td>
<td>8.0</td>
<td>11.4</td>
<td>16.3</td>
<td>21.7</td>
<td>26.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Semester</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Min Temperature</td>
<td>15.7</td>
<td>15.7</td>
<td>12.5</td>
<td>8.1</td>
<td>3.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Monthly Average Temperature</td>
<td>24.1</td>
<td>23.6</td>
<td>19.3</td>
<td>13.5</td>
<td>8.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Monthly Max Temperature</td>
<td>29.3</td>
<td>29.2</td>
<td>25.0</td>
<td>18.8</td>
<td>12.7</td>
<td>8.0</td>
</tr>
</tbody>
</table>
Figure 4-22  Humidity (%) in the Study Area in West Macedonia Region (Kozani station, National Meteorological Service)

<table>
<thead>
<tr>
<th></th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Semester Monthly Average Humidity</td>
<td>74.2</td>
<td>70.1</td>
<td>67.5</td>
<td>63.0</td>
<td>62.0</td>
<td>54.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd Semester Monthly Average Humidity</td>
<td>49.8</td>
<td>50.4</td>
<td>57.0</td>
<td>66.7</td>
<td>74.7</td>
<td>75.7</td>
</tr>
</tbody>
</table>
**Figure 4-23** Temperature in the Study Area in West Macedonia Region (Kozani station, National Meteorological Service)

<table>
<thead>
<tr>
<th>Month</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Rainfall Average</td>
<td>36.2</td>
<td>30.2</td>
<td>39.2</td>
<td>43.3</td>
<td>56.7</td>
<td>37.1</td>
</tr>
<tr>
<td>Total of Rain days</td>
<td>10.8</td>
<td>10.0</td>
<td>11.2</td>
<td>10.4</td>
<td>11.2</td>
<td>7.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Rainfall Average</td>
<td>38.1</td>
<td>30.0</td>
<td>31.7</td>
<td>52.8</td>
<td>60.3</td>
<td>52.0</td>
</tr>
<tr>
<td>Total of Rain days</td>
<td>5.6</td>
<td>5.1</td>
<td>6.2</td>
<td>8.1</td>
<td>10.7</td>
<td>11.7</td>
</tr>
</tbody>
</table>
Figure 4-24  Wind Speed (Kt) in the Study Area in West Macedonia Region (Kozani station, National Meteorological Service)
4.7 **ARCHAEOLOGY - CULTURAL HERITAGE**

4.7.1 **Introduction**

The desk research confirms substantial known cultural heritage within the larger study area of northern Greece. These same areas, without a doubt, possess substantial cultural heritage that have yet to be found, archaeological sites in particular. Development of the cultural heritage baseline and the archaeological appraisal of resources included in the Study Area corridor provide a basis for managing the known and potential resources over the course of the Project.

The mountainous hinterland of the western Macedonia is interrupted by fertile alluvium and diluvium basins watered by significant drainage systems such as the Aliakmonas River to the west, Axios River in the central part and Strymon River to the east. Human occupation has been favoured here through the centuries, attracted by the abundant resources of the region which include rich vegetation, an abundant water supply, mineral deposits and intermediate climate between continental Europe and the Mediterranean. Additional attractive factors have included strategic location in one of the Balkan Peninsula’s significant centers of production and population, including Kastoria, Florina, and Kozani basins as well as the plain extending from Thessaloniki to Edessa and Veroia. Due to its central location as southern entryway from Asia to Europe, Macedonia has been subject to constant population movements and thus has a complex cultural history.

4.7.2 **Areas of High Cultural Heritage Potential within the Study Area**

Areas of high cultural heritage potential or sensitivity were compiled from desk and field research and are presented in *Table 4.15*. These high potential areas have been identified based on landscape characteristics observed in the field and by relative density and type of known sites.
Table 4-15 Key Sections for Cultural Heritage Constraints (‘areas of main concern’)

<table>
<thead>
<tr>
<th>N.</th>
<th>Area</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ayios Athanassios, Gefyra, Nea Chalkidona area</td>
<td>Although no known sites are close to the proposed route in this section, the concentration of sites in the area make it an archaeologically sensitive area.</td>
</tr>
<tr>
<td>2</td>
<td>Pella area</td>
<td>The proposed route runs in parallel to a series of Macedonian tombs that constitute an archaeologically sensitive area. The route is at a distance of approximately 500 m from the boundaries of the protection zone of the designated site of Pella. The Study Area partially overlaps with the Southern part of the Pella protection zone.</td>
</tr>
<tr>
<td>3</td>
<td>Rizo-Petraia area</td>
<td>Located close to the designated archaeological site of Skydra and Petraia.</td>
</tr>
<tr>
<td>4</td>
<td>Polla Nera</td>
<td>The proposed route runs in parallel to an ancient cemetery located in Paliambela area</td>
</tr>
<tr>
<td>5</td>
<td>Ano Grammatiko</td>
<td>Ancient settlement in Ano Grammatiko area. Roman shells at settlement entrance.</td>
</tr>
<tr>
<td>6</td>
<td>Kato Grammatiko Fortress</td>
<td>Ancient stone fortress with 1.5 m thick, double wall.</td>
</tr>
<tr>
<td>7</td>
<td>Pirgi area</td>
<td>Important historic mountain pass. Ancient settlement not yet located accurately, may be close to the proposed route</td>
</tr>
<tr>
<td>8</td>
<td>Militsa</td>
<td>Ancient settlement close to the proposed route.</td>
</tr>
<tr>
<td>9</td>
<td>Argos Orestiko area</td>
<td>Important ancient centre archaeologically sensitive zone. Possibly some of the Argos Orestikon sites close to the proposed route.</td>
</tr>
<tr>
<td>10</td>
<td>Variko area</td>
<td>Concentration of old churches on the proposed route. Neolithic and Bronze Age pottery found in Kampos.</td>
</tr>
</tbody>
</table>

A total of 62 sites along the Study Area corridor were identified by a combination of desk and field study. Of these sites, 41 were identified by the desk study, and 21 were new finds identified for the first time during the field survey. Almost 58% of the route was visited during fieldwork. The most sensitive zone along this route is shown in Figure 4-25. Surveys with the authorities will define further actions on archaeological sites that lie within the 40m construction corridor.
Figure 4-25  Sensitive Cultural Heritage Zone within the Study Area

Cultural heritage sites identified within the Study Area date from Neolithic to Modern period. Types of sites included are: archaeological sites such as settlements, fortified sites, cemeteries, burial mounds and monuments such as churches, monasteries, towers, traditional bridges and ICH sites e.g. memorials, contemporary churches, traditional bridges.

Map 5 in Annex I shows the location of sites along the route, with an indication of the type of site according to the following categorisation.

- **Archaeological Site or high potential site/location**: Archaeological Sites or High Potential location within the Study Area, where a site is defined as any area with known or strongly suspected to have ancient below-ground cultural remains, artefacts, architectural foundations, or soil features (e.g. tomb, buried settlement or fortification, prehistoric camp site or village).
- **Monument (old building)**: Monuments within the Study Area where Monument is defined as an above ground structure with historic characteristics (e.g. old church, reconstructed ancient site, historic graveyard, old neighbourhood, any type of historic structure that is preserved above ground).

- **ICH (new churches and other resources)**: Intangible Cultural Heritage sites within the Study Area, where a ICH is defined as a place, structure, or other physical feature that has cultural importance not because of its special physical characteristics but because of its importance to a local group or community (ICH most often has no specific legal protection).

### 4.7.3 Cultural Heritage Indicators

*Table 4.16 presents the cultural heritage indicators for the Study Area.*

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of Cultural Heritage sites</td>
<td>45</td>
</tr>
<tr>
<td>Total indicator value from Archaeological Site or high potential site/location</td>
<td>120</td>
</tr>
<tr>
<td>Total indicator value from Monuments</td>
<td>42</td>
</tr>
<tr>
<td>Total indicator value from ICH (new churches and other resources)</td>
<td>11</td>
</tr>
</tbody>
</table>

### 4.8 Socioeconomic Environment

The following Sections present demographic information and socioeconomic environment for the Project. The Study Area for the socioeconomic environment is defined as the 11 municipalities crossed by the proposed pipeline route. The *broader* Study Area, considered for indicators such as health services and infrastructure, includes the area of Western and Central Macedonia.
4.8.1 Demographic Information

General Demographic Information

The 2001 national census demonstrates a slight population growth (2.95%) in West Macedonia Region and a larger population growth (9.8%) in Central Macedonia Region. Specifically, West Macedonia Region had a population of 301,522 people in total in 2001 and Central Macedonia Region had a population of 1,871,952 people. Approximately 17% of the population of Greece lives in Region of Central Macedonia, while a much smaller percentage of the population - approximately 2.8% - lives in West Macedonia.

As of 2001, approximately 346,000 people lived in the 11 municipalities of the Study Area (see Table 4.17). Pella had the largest population with 65,497 inhabitants, while Nestorio was the smallest, with only 3,500 people in 2001. Regarding population density, the most densely populated municipalities are located in the eastern part of the Study Area, in the Region of Central Macedonia, with Pella (98 inhabitants per km²) the most densely populated followed by Chalkidona and Alexandreia (90 inhabitants per km²). Nestorio, located in the south-west of the Study Area near the Albanian border, has the lowest population density, with six inhabitants per km².

### Table 4-17 Population per municipality in 2001

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Population 2001</th>
<th>Surface area (km²)</th>
<th>Density Inhabitants / km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalkidona</td>
<td>35,145</td>
<td>391</td>
<td>90</td>
</tr>
<tr>
<td>Alexandreia</td>
<td>43,209</td>
<td>482</td>
<td>90</td>
</tr>
<tr>
<td>Naousa</td>
<td>34,441</td>
<td>425</td>
<td>81</td>
</tr>
<tr>
<td>Edessa</td>
<td>29,799</td>
<td>611</td>
<td>49</td>
</tr>
<tr>
<td>Skydra</td>
<td>21,147</td>
<td>240</td>
<td>88</td>
</tr>
<tr>
<td>Pella</td>
<td>65,497</td>
<td>667</td>
<td>98</td>
</tr>
<tr>
<td>Eordea</td>
<td>46,540</td>
<td>708</td>
<td>66</td>
</tr>
<tr>
<td>Kastoria</td>
<td>35,093</td>
<td>762</td>
<td>46</td>
</tr>
<tr>
<td>Orestida</td>
<td>13,375</td>
<td>343</td>
<td>39</td>
</tr>
<tr>
<td>Nestorio</td>
<td>3,542</td>
<td>617</td>
<td>6</td>
</tr>
<tr>
<td>Amyntaio</td>
<td>18,512</td>
<td>590</td>
<td>31</td>
</tr>
</tbody>
</table>


The Study Area includes three medium to large population centres: Ptolemaida (28,679 inhabitants), Kastoria and Alexandreia (both around
16,000 inhabitants). All three are important to the wider area as they provide large health facilities (hospitals), economic activities and employment opportunities.

*Gender Ratio*

The gender ratio in the municipalities crossed by the pipeline route is almost exactly 1:1, with little variation across municipalities (1).

*Age Distribution*

Figure 4-26 presents the age distribution of each municipality within the Study Area. The age distribution in the Study Area is fairly even with the largest share of the population between the ages of 20-39 (29%), jointly followed by the 40-59 and over 60’s group (24% each) and finally the under 19’s group (23%). Table 4-18 below presents the age distribution for Greece and the municipalities in the wider Study Area. The Study Area has slightly fewer people of young working age (20-39) than the national average, and slightly more people over 60, but is broadly in line with the national distribution.

<table>
<thead>
<tr>
<th>Age Distribution</th>
<th>Up to 19</th>
<th>20-39</th>
<th>40-59</th>
<th>Over 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Greece</td>
<td>21.83%</td>
<td>30.51%</td>
<td>25.09%</td>
<td>22.57%</td>
</tr>
<tr>
<td>Municipalities in the Study Area</td>
<td>22.73%</td>
<td>28.36%</td>
<td>24.31%</td>
<td>24.60%</td>
</tr>
</tbody>
</table>

Nestorio represents an exception to the overall age breakdown in the Study Area; the largest age group in this municipality (30% population) is people over 60 years old. Nestorio is more distant from major population centres and has fewer economic opportunities, contributing to the movement of younger age groups out of the area.

(1)Census 2001, Hellenic Statistical Authority
Figure 4-26  Age Distribution by Municipality (% of the total population)

Census 2001, 1991, Hellenic Statistical Authority (graphic includes some municipalities along the route (see Section 6: Alternatives Assessment))

Age distribution at the settlement level is largely influenced by location in relation to the large population centres and industrial facilities. Larger settlements located close to employment and population centres tend to have a more even age distribution, while smaller and more remote settlements tend to have a larger percentage of people over age 60.

Migration and Population Change

Secondary data and interviews show that between the 1960’s and 1970’s population numbers in the municipalities in the Study Area dropped dramatically and many settlements lost more than 20%-30% of their population. Internal migration tended to occur from rural areas to large population centres such as Athens and Thessaloniki. External migration was towards the USA, Australia and Europe (mainly Germany). Lack of employment opportunities and poverty were the main driving forces for migration, particularly in rural areas.
Since the 1980’s the population in the area has remained relatively stable and no other dramatic changes have been observed. According to the 2001 census, the population increased slightly (by approximately 4%) between 1991 and 2001 for the Study Area as a whole, but some municipalities (Pella and Chalkidona) increased their population, while others (Nestorio, Naousa) declined in population over the period. Generally speaking, municipalities with large population centres and good transport connections grew as compared to the more remote areas.

**Figure 4-27** Population change (%) between 1991-2001

Source: Census 2001, 1991, Hellenic Statistical Authority (graphic includes some municipalities along the route (see Section 6: Alternatives Assessment)

**Religion and Ethnicity**

Greece is a fairly homogenous country, with the majority of the population being of Greek origin and Christian Orthodox religion. In the 1920s the area of Macedonia and Thrace received a large number of people of Greek origin from the Black Sea area (ancient Pontus) who came after the Convention Concerning the Exchange of Greek and Turkish Populations (1923), signed between Greece and Turkey in Lausanne. During the field visit many settlements were identified as having received some Pontic people during this time. These settlements are located throughout the broader area, with the largest numbers found in the west of the Study Area. It was reported that
some people still use the Pontiac dialect, but this is mainly amongst the older
generation and considered a secondary language to Greek.

There are a few Albanian families (1-2 families) in many settlements along the
route. These families came to the area after 1990 and according to the
settlement interviews they are fully integrated into the settlement society, they
speak Greek and their children attend Greek schools.

**Demographic and Settlements Indicators**

Table 4-19 presents the demographic and settlements indicators for the Study
Area. As explained in Section 4.3.4, although indicative and preliminary in
nature these provide a good understanding of the specific socioeconomic
baseline characteristics of the Study Area.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Regions crossed by the routing corridor</td>
<td>2 regions</td>
</tr>
<tr>
<td>Number of Municipalities crossed by the routing corridor</td>
<td>10 municipalities</td>
</tr>
<tr>
<td>Settlements located within the 2 km route corridor (based on the X,Y coordinate layer)</td>
<td>22 settlements</td>
</tr>
<tr>
<td>Population in settlements within the 2 km corridor (based on the X,Y coordinate layer)</td>
<td>approx 12000 (estimate using 2001 census data)</td>
</tr>
<tr>
<td>Population density within the 2 km corridor (based on the X,Y coordinate layer)</td>
<td>0.0032 (people/ha)</td>
</tr>
<tr>
<td>Number of settlements whose territories are crossed by the pipeline routing corridor</td>
<td>37 settlements</td>
</tr>
<tr>
<td>Total number of inhabitants within settlements located in the 2 km corridor (based on the settlement polygon layer)</td>
<td>Approx. 28500 (estimate using 2001 census data)</td>
</tr>
<tr>
<td>% of the municipalities’ population living in settlements affected by the 2km corridor (based on the settlement polygon layer)</td>
<td>8%</td>
</tr>
<tr>
<td>Settlements within 1km outside of the 2km corridor but potentially accessing resources within the corridor</td>
<td>49 settlements</td>
</tr>
</tbody>
</table>
4.8.2 Education

The Education System in Greece

According to the Greek Constitution, the government is required to offer free and mandatory educational services for all children ages 6 to 15 years (in other words, a mandatory 9-year educational system). The levels of education are as follows:

- Kindergarten - at the age of 5 years, which prepares children for elementary school
- Elementary school – ages 6 to 11, spanning 6 grades and providing basic education
- Gymnasium – ages 12 to 14, comprising 3 grades and constituting the last level of mandatory education in Greece

Students aiming at higher education have two options after Gymnasium:

- Lyceum, comprising 3 grades and preparing students for university or higher education institutions
- Training and/or vocational education in Technical-Vocational Educational Institutes (T.E.E).

The introduction to universities or higher education institutes is accomplished by pan-hellenic examinations. This system is currently criticised for putting too much emphasis to preparing students for higher education instead of providing knowledge per se. A reform of the system is currently under way.

Education in the Study Area

Figure 4-28 presents the education profile for West and Central Macedonia. A high percentage of people in both regions finish only primary education (elementary school), followed by people who finish high school or secondary
education (high school plus three years of lyceum). The educational profile is similar for both Central Macedonia Region and West Macedonia Region. A high percentage of people (between 10 and 15 percent) are recorded as either having dropped out of school or illiterate. More information on the educational profile of the Study Area and in the local areas crossed by the Base Case pipeline route will be collected during the ESIA stage.

**Figure 4-28  Education profile for West and Central Macedonia Regions**

![Graph showing education profile](image)

*Source: Census 2001, 1991, Hellenic Statistical Authority (graphic includes some municipalities along the route (see Section 6: Alternatives Assessment))*

Table 4-20 and Table 4-21 present more detailed educational profiles per municipality in Study Area. At the municipal level, Alexandreia has the highest percentage of people who either drop out school or are illiterate (more than 17% of the population), followed by Skydra municipality with more than 15% of the population in this category. Across all municipalities, the largest group of people are those who complete only primary school (six years of education), followed by those who complete either secondary education or high school. Approximately 69% of settlements within the 2km corridor have a primary school located within the settlement.
### Table 4-20  Population’s educational status per municipality of Central Macedonia Region

<table>
<thead>
<tr>
<th>Central Macedonia Region / Municipalities of the Study Area</th>
<th>PhD</th>
<th>Msc</th>
<th>Bsc</th>
<th>Technological Institutes</th>
<th>Obtained degree following secondary education</th>
<th>Finished secondary education</th>
<th>Technical High school</th>
<th>Technical Schools</th>
<th>Finished high school (by vocational)</th>
<th>Finished primary education/elementary</th>
<th>Studying at primary school</th>
<th>Drop out school but know how to read</th>
<th>Illiterate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalkidona</td>
<td>0.03</td>
<td>0.11</td>
<td>3.75</td>
<td>2.23</td>
<td>2.79</td>
<td>14.75</td>
<td>3.01</td>
<td>3.09</td>
<td>12.78</td>
<td>36.12</td>
<td>6.54</td>
<td>10.90</td>
<td>3.89</td>
</tr>
<tr>
<td>Alexandreia</td>
<td>0.06</td>
<td>0.12</td>
<td>3.24</td>
<td>2.03</td>
<td>2.26</td>
<td>13.44</td>
<td>2.38</td>
<td>2.30</td>
<td>10.98</td>
<td>39.26</td>
<td>6.80</td>
<td>10.70</td>
<td>6.44</td>
</tr>
<tr>
<td>Naousa</td>
<td>0.05</td>
<td>0.12</td>
<td>4.83</td>
<td>2.64</td>
<td>2.93</td>
<td>14.52</td>
<td>3.12</td>
<td>3.12</td>
<td>10.69</td>
<td>38.63</td>
<td>6.46</td>
<td>9.54</td>
<td>3.36</td>
</tr>
<tr>
<td>Edessa</td>
<td>0.04</td>
<td>0.15</td>
<td>6.30</td>
<td>2.86</td>
<td>2.51</td>
<td>17.16</td>
<td>2.80</td>
<td>2.82</td>
<td>10.20</td>
<td>35.20</td>
<td>7.06</td>
<td>9.24</td>
<td>3.66</td>
</tr>
<tr>
<td>Skydra</td>
<td>0.04</td>
<td>0.12</td>
<td>3.29</td>
<td>1.46</td>
<td>2.61</td>
<td>14.22</td>
<td>2.09</td>
<td>2.93</td>
<td>11.46</td>
<td>39.76</td>
<td>6.76</td>
<td>10.61</td>
<td>4.66</td>
</tr>
<tr>
<td>Pella</td>
<td>0.03</td>
<td>0.08</td>
<td>4.32</td>
<td>1.72</td>
<td>2.43</td>
<td>13.54</td>
<td>2.94</td>
<td>2.45</td>
<td>11.76</td>
<td>39.18</td>
<td>7.03</td>
<td>9.99</td>
<td>4.53</td>
</tr>
</tbody>
</table>

### Table 4-21  Population’s educational status per municipality of Western Macedonia Region

<table>
<thead>
<tr>
<th>West Macedonia Region / Municipalities of the Study Area</th>
<th>PhD</th>
<th>Msc</th>
<th>Bsc</th>
<th>Technological Institutes</th>
<th>Obtained degree following secondary education</th>
<th>Finished secondary education</th>
<th>Technical High school</th>
<th>Technical Schools</th>
<th>Finished high school (by vocational)</th>
<th>Finished primary education/elementary</th>
<th>Studying at primary school</th>
<th>Drop out school but know how to read</th>
<th>Illiterate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eordea</td>
<td>0.05</td>
<td>0.10</td>
<td>5.46</td>
<td>3.17</td>
<td>3.12</td>
<td>16.74</td>
<td>4.84</td>
<td>4.88</td>
<td>11.96</td>
<td>31.26</td>
<td>8.20</td>
<td>7.43</td>
<td>2.79</td>
</tr>
<tr>
<td>Kastoria</td>
<td>0.07</td>
<td>0.21</td>
<td>5.41</td>
<td>2.43</td>
<td>2.23</td>
<td>18.59</td>
<td>2.02</td>
<td>1.02</td>
<td>12.39</td>
<td>39.73</td>
<td>6.50</td>
<td>6.56</td>
<td>2.82</td>
</tr>
<tr>
<td>Orestida</td>
<td>0.08</td>
<td>0.09</td>
<td>5.41</td>
<td>2.08</td>
<td>2.45</td>
<td>16.32</td>
<td>1.29</td>
<td>1.18</td>
<td>11.60</td>
<td>42.85</td>
<td>6.22</td>
<td>7.29</td>
<td>3.16</td>
</tr>
<tr>
<td>Nestorio</td>
<td>0.18</td>
<td>0.06</td>
<td>3.95</td>
<td>1.78</td>
<td>1.54</td>
<td>11.63</td>
<td>1.60</td>
<td>1.54</td>
<td>10.36</td>
<td>48.55</td>
<td>5.34</td>
<td>8.78</td>
<td>4.69</td>
</tr>
<tr>
<td>Amyntaio</td>
<td>0.05</td>
<td>0.08</td>
<td>4.20</td>
<td>2.15</td>
<td>2.24</td>
<td>12.08</td>
<td>4.79</td>
<td>3.10</td>
<td>11.32</td>
<td>38.17</td>
<td>6.63</td>
<td>11.84</td>
<td>3.36</td>
</tr>
</tbody>
</table>
4.8.3 Economic Development

The Gross Regional Product (GRP) of Central Macedonia was equal to 13.9% of Greece’s total Gross National Product (GNP) in 2004 (23.372 billion Euro). Approximately 65.6% of the total GRP is produced in Thessaloniki (15.341 billion Euro). Average GRP per capita in Central Macedonia was approximately 68.2% of the European Union average in 2004. The Gross Regional Product (GRP) of West Macedonia equalled 2.3% of Greece’s total Gross National Product (GNP) in 2004. Approximately 55.6% of total GRP for the region is produced in Kozani, to the south of the Study Area. The fastest growing municipality in the Study Area was Kastoria, with 10.1% growth for the years 2000-2007. Average GRP per capita in West Macedonia for the year 2004 was 14867 Euros, with Kozani having the largest in the region (15790 Euros) followed by Kastoria (15788 Euros).

Agriculture, forestry and fishing (the primary sector) contributed only 6.4% of total gross value added for the Central Macedonia Region in 2004 and 7.2% in West Macedonia, while the secondary sector (including manufacturing, energy and construction) contributed 20.6% and 31.8% of Gross Value Added in Central and West Macedonia, respectively. Finally, the services sector (including tourism, communications, transport, etc) contributed 54.3% of total Gross Value Added in Central Macedonia and 45.5% in West Macedonia.

At the settlement level, secondary data on economic growth and the economic importance of different sectors was last updated in 2001. As a result, additional information will be collected to provide an up to date picture of local economic development during the full ESIA.

4.8.4 Employment and Livelihoods

Despite contributing a relatively small amount to the regional economy, agricultural activities and animal husbandry remain the dominant economic activity in terms of employment within the Study Area, followed by manufacturing and trade. Eordea has the lowest percentage of people working in agriculture in the Study Area (6%) and the highest percentage of people working in energy (6%) and construction (11%). This is due to employment opportunities in PPC lignite mines and PPC power plants, which are located in the Ptolemaida area.
Table 4-22 below presents the economic activity by municipality (% of total employed).

Agriculture (primary sector)

Skydra Municipality has the largest percentage of people in the agricultural sector (45%) followed by Pella and Alexandreia with 39% and 38% respectively. All three municipalities are located on the eastern end of the Study Area, where agricultural land makes up more than 70% of the total area. The majority of settlements that are involved in agriculture focus on crop production and only a small number are involved in animal husbandry. Agriculture is discussed further in Section 4.9 (Land Use).

Manufacturing, mining and construction (secondary sector)

Manufacturing is the second most important economic activity in the Study Area. In the municipalities of Kastoria, Nestorio, Veroia, Skydra and Chalkidona, more than 20% of the working population is engaged in the manufacturing industry. Until the late 1990’s the fur industry was thriving and employed many people, especially in Kastoria and Nestorio. However, in the past decade the industry has been in decline (primarily due to competition from countries in Asia) thus reducing the percentage of people employed in this activity and leading to both unemployment and underemployment in the area.

The energy sector, including lignite and nickel mining and related industrial activities, employs large numbers of people in Eordia and a growing number of people in Amyntaio, particularly in the expanding population centres (Ptolemaida and Amyntaio) in the area. Construction is also an important source of employment in these areas.

Trade and Services (tertiary sector)

Trade is important to the local economy and found in almost every settlement and local community. Many people own small shops, cafes or small businesses, and almost every settlement has at least one café and small food market. Trade is particularly important for settlements located close to large population centres. Table 4.23 presents the number of trade and retail businesses by regional entity (one administrative level above municipality) in the Study Area.
Table 4-22  Economic Activity per municipality (% of total employed)

<table>
<thead>
<tr>
<th>Sector / Municipality</th>
<th>Chalkidona</th>
<th>Alexandreia</th>
<th>Naousa</th>
<th>Edessa</th>
<th>Skydra</th>
<th>Pella</th>
<th>Eordea</th>
<th>Kastoria</th>
<th>Orestida</th>
<th>Nestorio</th>
<th>Amyntaio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, animal hunting</td>
<td>23.74</td>
<td>38.45</td>
<td>26.38</td>
<td>26.44</td>
<td>45.97</td>
<td>39.07</td>
<td>6.26</td>
<td>12.62</td>
<td>18.98</td>
<td>27.91</td>
<td>26.53</td>
</tr>
<tr>
<td>Fishery</td>
<td>0.03</td>
<td>0.09</td>
<td>0.00</td>
<td>0.04</td>
<td>0.00</td>
<td>0.03</td>
<td>0.00</td>
<td>0.17</td>
<td>0.02</td>
<td>0.08</td>
<td>0.26</td>
</tr>
<tr>
<td>Mines and Quarries</td>
<td>0.13</td>
<td>3.62</td>
<td>0.03</td>
<td>0.21</td>
<td>0.16</td>
<td>0.17</td>
<td>8.35</td>
<td>0.25</td>
<td>0.04</td>
<td>0.24</td>
<td>1.16</td>
</tr>
<tr>
<td>Energy and Water Supply</td>
<td>0.24</td>
<td>0.81</td>
<td>0.54</td>
<td>1.85</td>
<td>0.33</td>
<td>0.39</td>
<td>13.19</td>
<td>0.62</td>
<td>0.54</td>
<td>0.55</td>
<td>6.95</td>
</tr>
<tr>
<td>Trade and other</td>
<td>13.04</td>
<td>11.22</td>
<td>12.05</td>
<td>11.30</td>
<td>8.86</td>
<td>10.54</td>
<td>13.18</td>
<td>12.09</td>
<td>10.23</td>
<td>5.77</td>
<td>8.75</td>
</tr>
<tr>
<td>Hotels and Restaurants</td>
<td>4.06</td>
<td>3.17</td>
<td>4.13</td>
<td>4.73</td>
<td>2.93</td>
<td>3.42</td>
<td>5.15</td>
<td>5.53</td>
<td>4.04</td>
<td>4.27</td>
<td>4.49</td>
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<tr>
<td>Logistics</td>
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<td>3.21</td>
<td>2.86</td>
<td>4.09</td>
<td>2.53</td>
<td>3.35</td>
<td>3.06</td>
<td>2.54</td>
<td>2.92</td>
<td>3.00</td>
<td>3.88</td>
</tr>
<tr>
<td>Finance</td>
<td>0.67</td>
<td>0.74</td>
<td>0.98</td>
<td>1.39</td>
<td>0.75</td>
<td>1.17</td>
<td>1.30</td>
<td>1.58</td>
<td>1.14</td>
<td>0.71</td>
<td>0.88</td>
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<tr>
<td>Business and Real Estate</td>
<td>3.36</td>
<td>2.60</td>
<td>4.27</td>
<td>3.56</td>
<td>2.93</td>
<td>2.67</td>
<td>3.82</td>
<td>3.65</td>
<td>2.85</td>
<td>3.00</td>
<td>2.49</td>
</tr>
<tr>
<td>Public Sector and Defence</td>
<td>3.38</td>
<td>3.79</td>
<td>3.33</td>
<td>5.94</td>
<td>4.01</td>
<td>3.68</td>
<td>5.26</td>
<td>6.74</td>
<td>6.19</td>
<td>9.01</td>
<td>5.68</td>
</tr>
<tr>
<td>Education</td>
<td>3.37</td>
<td>2.88</td>
<td>4.61</td>
<td>6.16</td>
<td>2.41</td>
<td>3.97</td>
<td>6.49</td>
<td>5.15</td>
<td>4.89</td>
<td>2.69</td>
<td>4.27</td>
</tr>
<tr>
<td>Health and Social services</td>
<td>1.94</td>
<td>1.87</td>
<td>3.03</td>
<td>4.15</td>
<td>1.58</td>
<td>2.69</td>
<td>3.70</td>
<td>3.05</td>
<td>2.63</td>
<td>2.29</td>
<td>2.56</td>
</tr>
<tr>
<td>Social and Personal Services</td>
<td>1.85</td>
<td>1.83</td>
<td>2.15</td>
<td>2.45</td>
<td>1.81</td>
<td>1.87</td>
<td>2.41</td>
<td>2.78</td>
<td>1.88</td>
<td>1.74</td>
<td>1.84</td>
</tr>
<tr>
<td>Private houses occupying employee</td>
<td>0.26</td>
<td>0.15</td>
<td>0.21</td>
<td>0.43</td>
<td>0.14</td>
<td>0.20</td>
<td>0.17</td>
<td>0.27</td>
<td>0.16</td>
<td>0.08</td>
<td>0.13</td>
</tr>
<tr>
<td>Institutions</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
### Table 4-23  Number of Businesses in trade-and Service Sector by Regional Entity for 2001

<table>
<thead>
<tr>
<th>Region</th>
<th>Regional Entity</th>
<th>Municipalities</th>
<th>Number of wholesale businesses</th>
<th>Number of retail businesses</th>
<th>Number of restaurants-hotels</th>
<th>Number of car trade businesses</th>
<th>Number of intermediaty-finance-banking organizations</th>
<th>Number of education services</th>
<th>Number of health relating services</th>
<th>Number of other services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Macedonia</td>
<td>Thessaloniki</td>
<td>Chalkidona</td>
<td>9444</td>
<td>17593</td>
<td>5247</td>
<td>3321</td>
<td>309</td>
<td>567</td>
<td>374</td>
<td>19501</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Raebro</td>
<td>740</td>
<td>2648</td>
<td>1095</td>
<td>562</td>
<td>43</td>
<td>44</td>
<td>23</td>
<td>1758</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Naousa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edessa</td>
<td>632</td>
<td>2380</td>
<td>1161</td>
<td>543</td>
<td>32</td>
<td>48</td>
<td>40</td>
<td>1401</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skydra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pella</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eordea</td>
<td>812</td>
<td>2856</td>
<td>1412</td>
<td>543</td>
<td>38</td>
<td>41</td>
<td>4</td>
<td>2051</td>
</tr>
<tr>
<td>West Macedonia Region</td>
<td>Kozani</td>
<td>Eordea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kastoria</td>
<td>372</td>
<td>870</td>
<td>500</td>
<td>131</td>
<td>9</td>
<td>8</td>
<td>15</td>
<td>528</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kastoria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Orestida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nestorino</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Florina</td>
<td>150</td>
<td>990</td>
<td>648</td>
<td>160</td>
<td>14</td>
<td>14</td>
<td>6</td>
<td>581</td>
</tr>
</tbody>
</table>

*Source: Hellenic Statistical Authority*
Unemployment

At the municipality level, employment in the Study Area ranges from over 90% (Chalkidona) to over 75% (Orestida). The highest unemployment levels are registered in municipalities in the west: in Orestida, Nestorio and Kastoria over 20% of the total economically active population is unemployed. In eight of the 14 municipalities young people account for over 50% of those registered as unemployed (see Table 4.24).

Table 4-24  Employment and Unemployment by Municipality

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Employed (% of the economically active)</th>
<th>Unemployed (% of the economically active)</th>
<th>Young among unemployed (% of the unemployed)</th>
<th>Non active economically (% of the population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalkidona</td>
<td>90.05</td>
<td>9.95</td>
<td>46.54</td>
<td>53.99</td>
</tr>
<tr>
<td>Alexandreia</td>
<td>87.71</td>
<td>12.29</td>
<td>58.58</td>
<td>52.71</td>
</tr>
<tr>
<td>Naousa</td>
<td>85.13</td>
<td>14.87</td>
<td>48.33</td>
<td>53.00</td>
</tr>
<tr>
<td>Edessa</td>
<td>87.83</td>
<td>12.17</td>
<td>53.75</td>
<td>55.90</td>
</tr>
<tr>
<td>Skydra</td>
<td>89.06</td>
<td>10.94</td>
<td>57.13</td>
<td>50.68</td>
</tr>
<tr>
<td>Pella</td>
<td>89.31</td>
<td>10.69</td>
<td>61.47</td>
<td>50.99</td>
</tr>
<tr>
<td>Eordea</td>
<td>86.95</td>
<td>13.05</td>
<td>61.86</td>
<td>60.10</td>
</tr>
<tr>
<td>Kastoria</td>
<td>76.42</td>
<td>23.58</td>
<td>38.09</td>
<td>52.65</td>
</tr>
<tr>
<td>Orestida</td>
<td>75.59</td>
<td>24.41</td>
<td>38.14</td>
<td>54.39</td>
</tr>
<tr>
<td>Nestorio</td>
<td>76.28</td>
<td>23.72</td>
<td>37.67</td>
<td>61.12</td>
</tr>
<tr>
<td>Amyntaio</td>
<td>86.69</td>
<td>13.31</td>
<td>59.85</td>
<td>59.41</td>
</tr>
</tbody>
</table>
During the field visit it was reported that unemployment and underemployment are a major concern in the Study Area settlements. Unemployment levels for settlements located in the broader area of Kastoria are over 30%. Part time employment, especially among non-qualified people is extremely common (unlike the rest of Greece), particularly for settlements close to PPC mines and power plants. However, it was reported that part-time employment has experienced a radical decrease due to a decreased need for workers by the PPC in the past few years resulting in high unemployment in affected settlements. Additional information on unemployment levels at the settlement level will be collected during the ESIA fieldwork.

Household Income

There are no statistical data on household income and during field visits people were very reluctant to provide information concerning income. Interviews with the Heads of Local Communities indicated that income levels from crop production are low as a result of reduced market prices and the halting of subsidies. It was also reported that in settlements with high unemployment levels families are often reliant on one person’s pension. However, it was underlined that the number of families receiving social aid is extremely low. It is unclear as to the reasons for this but could be associated with the complexity of the criteria for receiving aid and the fact that many individuals are involved in short term temporary work on agriculture.

Additional information on household income and social aid will be collected during the full ESIA.

Poverty

During the field trips none of the local authorities reported people living in poverty, replying instead that families tend to support each other. As with most of Greece virtually every family owns their residence, which is shared by unemployed members of the family.

Baseline data collection during the ESIA study will further inform an understanding of the extent and distribution of poverty in the Study Area.
4.9 **LAND USE**

4.9.1 **Land Uses**

Figure 4-29 shows the land uses in the Study Area based on the CORINE land use definitions \(^1\). The land use map is presented in *Map 3 of Annex 1*.

**Figure 4-29** Land Uses according to the CORINE Land Cover reclassification (% per municipality)

Agriculture is the primary land use throughout the Study Area, covering large areas of Chalkidona, Pella and Alexandreia Municipalities in the east and Kastoria, Orestida and Nestorio Municipalities in the west. Agricultural land prevails in municipalities around Lake Giannitsa, which was drained during the 1930s in order to increase access to agricultural land. Agricultural land in Chalkidona municipality covers more than 90% of the total area, while in Alexandreia, Pella and Skydra it covers more than 89%, 78% and 61% respectively. For the rest of the municipalities, agricultural land coverage is on

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\(^1\) This provides a consistent data source for comparisons with data on other land uses in the area. However, this data is from 2000 and ground-truthing during the field visits confirmed that the CORINE underestimates the presence of permanent crops in the Study Area as well as identifying some areas of permanent crops that no longer exist.
average 37% of total municipal land. Nestorio municipality has the lowest agricultural land coverage, representing only 13% of its total municipal land.

In the southern part of the Study Area the main crops are wheat and feed for livestock, while in the east the focus is on olives, vineyards peaches, cherries and apricots. In addition greenhouses for tomatoes, beans and cucumbers are also located in this area. Apple tree plantations cover large areas in the north of Eordea Municipality. Heading to the west of the Study Area cereals (wheat, barley) along with beans are the dominant cultivations.

Forested land, which is under the authority of the regional forestry, can be found in the mountainous areas of Naousa.

In the middle of the Study Area there are large areas of industrial land, which comprises of several lignite mines (in the municipalities of Eordea and Amyntaio), lignite power plants, a nickel mine (in Kastoria), an automatic bottling water plant (in Amyntaio close to Xino Nero) and the largest high voltage centre in Greece (located close to Ptolemaida).

Each municipality has a capital which is usually the largest settlement in the municipality. In general the area is characterised by several large population centres and many small settlements ranging in size from less than 5 people to more than 3,000.

In the broader area of Central and West Macedonia Region, there are five designated industrial areas, located in Thessaloniki, Edessa, Pella-Imathia, Kastoria and Kozani respectively. However, none of these industrial areas are located in the Base Case route.

4.9.2 Land Ownership

Land distribution in the Study Area was carried out by the Greek State between 1930 and 1934. During this period the Greek State redistribute the land that had previously belonged to Ottoman Empire to landless people of the area. According to settlement interviews and published data, every married couple received 3.2 ha of land. The majority of land within the Study Area remains privately owned. There are a few large land parcels, but the most people own is a total of between 5-6 ha. The properties are usually fragmented, and each land parcel is generally quite small in size.
The majority of forests are publicly owned and each region or regional entity is the competent authority responsible for managing the forested land. Part of the publicly owned forests are designated and mapped as ‘managed forest’. There are some communal forests that belong to the local community, but the Regional Forestry Agency as overall responsibility and authority for any activity carried out in the forest. It was reported by the Head of the Local Community Councils during the field trip that every year the Regional Directorate of Forests decides on the areas and quantities of forest allocated for logging on both the publicly managed and communal forests. All logging is carried out, under the Forestry Agency’s supervision, for domestic purposes (mainly firewood) and there is no commercial logging activities reported in the Study Area. In addition there are small areas of communal land, but this is predominantly non-arable land, usually on the slopes of mountainous areas, which is sometimes used for pastoral purposes.

Local Economy, Land Use and Livelihood Indicators

The following Table 4.25 presents the local economy, land use and livelihood indicators for the Study Area, i.e the 2 km routing corridor (and where such detail is available at this stage also for the 40 metres construction corridor). As explained in Section 4.3.4, although indicative and preliminary in nature these provide a good understanding of the specific socioeconomic baseline characteristics of the Study Area.

<table>
<thead>
<tr>
<th>Table 4-25</th>
<th>Local Economy, Land Use and Livelihood Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Within corridor:</td>
</tr>
<tr>
<td></td>
<td>2 km</td>
</tr>
<tr>
<td>Area of agricultural lands</td>
<td>28080 ha</td>
</tr>
<tr>
<td>Area of permanently irrigated agricultural land</td>
<td>6,650 ha</td>
</tr>
<tr>
<td>Area of grazing lands</td>
<td>107 ha</td>
</tr>
<tr>
<td>Area of permanent crops (fruit trees, vineyards and olive groves) (CORINE)</td>
<td>1,317 ha</td>
</tr>
<tr>
<td>Area of permanent crops (fruit trees, vineyards and olive groves) within the 2 km corridor (municipality information)</td>
<td>4940 ha</td>
</tr>
<tr>
<td>Area of active mineral extraction within the corridor</td>
<td>0 ha</td>
</tr>
<tr>
<td>PPC concession areas crossed by the corridor</td>
<td>4,940 ha</td>
</tr>
<tr>
<td>Area occupied by industrial and commercial units</td>
<td>0.5 ha</td>
</tr>
<tr>
<td>Percent of settlements located fully or partially within the 2 km corridor that are reliant on agriculture as their main economic activity</td>
<td>68 %</td>
</tr>
<tr>
<td>Percent of settlements located fully or partially within the 2 km corridor that are reliant on industry as their main economic activity</td>
<td>29 %</td>
</tr>
</tbody>
</table>
### 4.10 Infrastructure and Public Services

#### 4.10.1 Transport Infrastructure

**Road Network**

Roads are a vital community lifeline affecting access to employment, markets, services and health care provisions.

All primary and secondary roads within the 2 km corridor are asphalted and all settlements within the 2 km corridor are connected to the road network. All of the regional entities have their own transport service connecting settlements inside the regional entity borders. There are also road connections to large city centres in neighbouring regional entities and towards Athens and Thessaloniki. The Engatia Highway passes Alexandreia, Veroia, and Kozani before heading south. A section of the highway also heads north to Kastoria, providing a critical connection to the cities to the east. The Engatia Highway is extremely important to the region, and has significantly reduced the time needed to access large population centres – particularly Kastoria, - thus providing better access to services, markets and jobs for people living in smaller settlements.
Figure 4-30  Egnatia Highway in Central Macedonia Region

Source: http://www.egnatia.gr/page/default.asp?la=2&id=5

Railway Network

The Hellenic Railways Organisation or OSE, is the Greek national railway company which owns, maintains and operates all railway infrastructure in Greece. The current network comprises 2552 km, from which 70% are standard gauge lines (1435 mm width). ¹

The backbone of the network is the line from Athens to Thessaloniki. West Macedonia is connected to Thessaloniki through a dedicated line, which runs from Thessaloniki to Edessa, Amyntaio, Kozani, and Florina.

Harbours

The ports of Thessaloniki (Central Macedonia), Kavala and Alexandroupoli (East Macedonia - Thraki) are major nodes of sea transport in the area. A

¹ Source: OSE, www.ose.gr
number of smaller ports (Stavros, Porto Lagos, Keramoti, Eletheres, Thassos, Limenaria Thassou, Kamariotissa Samothrakis) in the Region of East Macedonia – Thraki mainly accommodate local needs, while there are plenty of small harbours for sailing boats and fishing boats (Platamonas, Katerini, Pidna, Gritsa Litoxorou, Moudania, Ormos Panagias etc).

According to data from the Port Authority of Thessaloniki, the port of Thessaloniki accounts for international cargo in the order of 6% of GDP or about 40% of the Gross Product for the Region of Central Macedonia. On an annual basis, the port receives or dispatches about 15,000,000 tonnes of cargo, from which 7,000,000 tonnes is general cargo while 8,000,000 tonnes is liquid fuels. In addition, nowadays the port services about 3,500 vessels, carrying more than 200,000 passengers and 250,000 container units (1).

Airports

The International Airport "Macedonia" (Thessaloniki Airport) is the second biggest airport in Greece, connecting Thessaloniki with other Greek cities and a number of international destinations.

The airports of Kastoria and Kozani in West Macedonia are of less importance and connect the region only to Athens (2).

4.10.2 Energy Supply – Electricity Transmission Network

Public Power Corporation Networks and Plants

Established in 1950, Public Power Corporation s.a. (PPC) is the largest power generation company in Greece and the country's sole power supply company. PPC is the only company with a fully owned power transmission system in Greece owning 93% of the installed power capacity in Greece. It is owned by the Greek State by 50.5%, while the remaining 49.5% is owned by various shareholders.

PPC lignite power plants in the broader area are mainly located close to Ptolemaida-Kozani and Amuntaio.

(1) Operational Programme of Central Macedonia, Programming Period 2007 – 2013, Region of Central Macedonia
(2) Operational Programme of Central Macedonia, Programming Period 2007 – 2013, Region of Central Macedonia.
Table 4.26 lists PPC’s Power plants in the Study Area and their installed capacity. Close to Ptolemaida is located PPC High Voltage Centre which is the largest in Greece. There is also a dense power supply network (400 kV and 150 kV transmission lines) in the Study Area.

**Table 4-26  Public Power Corporation Power plants in the Broader Study Area**

<table>
<thead>
<tr>
<th>Power plant</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPP Liptol</td>
<td>10+33 = 43</td>
</tr>
<tr>
<td>TPP Ptolemaida</td>
<td>70 + 2x125 + 300 = 620</td>
</tr>
<tr>
<td>TPP Kardia</td>
<td>2x300 + 2x325 = 1,250</td>
</tr>
<tr>
<td>TPP Agios Dimitrios</td>
<td>2x300+2x310+375 = 1,595</td>
</tr>
<tr>
<td>TPP Amuntaio</td>
<td>2x300 = 600</td>
</tr>
<tr>
<td>TPP Melitis-Achladas</td>
<td>1x330 = 330</td>
</tr>
</tbody>
</table>

4.10.3  Telecommunications

Every settlement has a fixed telephone connection and mobile phone coverage is widespread. In addition, the main population centres and most of the settlements have access to broadband internet. Generally speaking, telecommunication infrastructure is owned and run by the Greek Telcommunications Organisation (OTE), but there has been a more recent trend toward privatisation (by companies such as WIND, FORTHNET, HOL), particularly in large cities.

4.10.4  Technical Infrastructure

**Irrigation System**

There are no official records of irrigation systems in the broader area. However, according to information gathered during meetings with municipalities and settlements there is an extensive irrigation network in Chalkidona, Pella and Alexandreia municipalities in the east of the Study Area. However, also further to the west, the route passes through areas with local irrigation systems (trickle irrigation of orchards, irrigation of maize fields etc.).
In Chalkidona municipality, where the pipeline predominantly crosses areas of high quality agricultural land (mostly corn, sugar beet, cotton), there is an extensive irrigation network between Gefura, Valtochorion, Parthenion and Mikro Monastirion.

Alexandreia municipality also has an extensive irrigation network which was built during the 1990’s. It is formed by an underground network of primary and secondary plastic pipes, installed 2.5 and 1 m below ground level (respectively). The primary pipes are parallel and 500m distant from each other and have a diameter of 50 cm. The secondary pipes are 15-20 cm in diameter and perpendicular to the primary network. At Giannitsa, the irrigation system is based on surface channels.

Irrigation in the western portion of the Study Area is less likely to be located underground. Additional information will be collected during the full ESIA study to confirm the location and type of irrigation in any areas crossed by the pipeline route.

**Water Supply and Sewerage Infrastructure**

Regarding water provision, all towns, cities and settlements have access to drinking water. In all capital cities and many other large city centres in the area the water and sanitation is provided by water supply and sewerage municipal companies. All the settlements have a water supply network which is either managed by the municipal authority or a private company. Most of the settlements in the Study Area have no sewerage system. Each house has its own drainage pit and the owner of the house is the responsible for maintaining it.

**Waste management Infrastructure**

Waste collection is a municipality responsibility and waste is collected from each settlement. However, in many settlements illegal dumping was reported as being common practice until recently. There is only one sanitary landfill covering all of the West Macedonia Region, located in Kozani.

### 4.10.5 Health Care Services

There are eight general hospitals in large city centres in the broader area of the pipeline route, and many health centres in smaller towns or villages. Settlements without permanent health care facilities are visited by a doctor,
usually once or twice per week. Table 4.27 presents permanent health care facilities (hospitals and health centres) in the municipalities of the Study Area. Approximately 90% of settlements within the 2 km corridor are within 15 km of a hospital or clinic and all settlements are within 20 km of a hospital or a health centre.

<table>
<thead>
<tr>
<th>Region</th>
<th>Regional Entity</th>
<th>Municipalities</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thessaloniki</td>
<td>Chalkidona</td>
<td>Health Centre of Koufalia</td>
<td></td>
</tr>
<tr>
<td>Delta</td>
<td>Health Centre of Chalastra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imathia</td>
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More detailed information on access to health care and health status will be collected during the full ESIA.
5 PRODUCTION DESCRIPTION

5.1 GENERAL DESCRIPTION

5.1.1 Overview of the Project

The pipeline system through Greece would initially consist of an approximately 181 km long pipeline with a capacity of 10 BCM of natural gas per year. In line with international best practice, block valve stations will be installed approximately every 30 km of the pipeline to enable to interrupt the gas flow in case of maintenance or emergency. Subject to further system studies, a compressor station (CS02) may be placed in Greece near the border to Albania with preferred location (Alternative C) approx 2 km to the West of the town of Mesopotamia for the system capacity’s expansion from initial 10 to later 20 BCM/y. For 10 CBM a metering station will be established that would in the 20 BCM/y case expanded to the CS02. Figure 5-1 shows the TAP route in Greece (also refer to Map 1 -Annex l). The figure shows the 2 km wide routing corridor (1 km width either side of the proposed centreline).

Figure 5-1 TAP Route (Base Case) in Greece
It is further envisaged that the TAP Project will be expanded to the east to include a section from Nea Messimvria to Komotini (located in East Macedonia and Thrace Region) which will mainly follow existing pipeline routes. For this additional section, an Environmental Pre-licence has already been issued by the Special Environmental Service of the Ministry of Environment Energy and Climate Change. Additional information that will be required to integrate this new section into the TAP Project will be submitted to the authorities at a later date with a view to providing a full ESIA report that includes the complete route: Komotini to the Albanian border.

The following sections describe the technical approach for the section from Nea Messimvria to the Albanian border.

### 5.1.2 Overview of Project Schedule

Construction of the Project is anticipated to commence in the beginning of 2014, and will last for approximately 3 years. It is envisaged that preparation of auxiliary facilities as camp site, access roads etc. would be started in advance around mid 2013. Commissioning of the Project is envisaged for 2018. The detailed Project schedule is presented in Annex III.

### 5.1.3 Design Philosophy

The pipeline is designed for a technical life time of 50 years. The design life time for equipment and piping of the stations is 25 years. The design shall assure that the gas transport system fulfils all safety requirements of the National and European Codes and Standards.

The pipeline and station shall be designed in accordance with requirements resulting from:

- National and local regulations;
- Safety of the public and personal working near to the pipeline;
- Protection of the environment;
- Protection of property and facilities;
- Geotechnical, corrosivity and hydrographical conditions;
- Requirements for construction, operation and maintenance;
- Third party activities.
5.1.4 System Throughput

The route selection was undertaken under the following overall considerations:

- TAP AG’s philosophy to undertake the project in line with international best practice standards and the relevant EBRD Performance Requirement (PR3)

The route selection was undertaken under the following overall considerations:

- The pipeline shall be designed in accordance with the EU Norms and local standards (in some cases other international standards such as API, ASME may be used), whereby the more stringent rules apply.
- Avoidance routing was the primary approach to selected constraints that are identified and mapped inside an investigated corridor. For areas where avoidance of the identified geo-hazards and selected constraints is not entirely possible, the relevant sections of infringement have to be “earmarked” for closer investigation during the subsequent site investigations and other studies.
- Parallel route with other infrastructures is preferred (*so-called “infrastructure bundling”*).
- Crossings with other existing and/or planned infrastructural installations shall be kept as short as possible (ideally in 90 degree).
- The pipeline shall be installed in geologically stable areas with a gentle topography – side slopes and land slide areas must be avoided.

### 5.1.4 System Throughput

The pipeline transportation capacity may be increased from an initial throughput of 10 billion cubic meters per year (BCM/y) to 20 BCM/y. For the 10 BCM phase the TAP system requires two compressor stations (CS00 in Greece, on the section Komotini- Nea Messimvria and CS03 in Albania near the Adriatic coast). Two additional compressor stations will be implemented for the expansion to 20 BCM phase (CS01 on the section Komotini – Nea Messimvria and CS02 near the border to Albania). CS02 will be developed as a metering station from the beginning and expanded to a compressor station later on to increase the throughput from 10 BCM to 20 BCM. Depending on further technical system studies, CS02 will be either located in Albania near the Albania/Greek border or on the Greek side near the border or on the Greek side approx 10 km away from the border in vicinity of Mesopotamia.

The pipeline shall have a design pressure of 95 barg (bars above atmospheric pressure), which shall be sufficient for the TAP capacity base case of 10 BCM/y as well as for the potential future extension of the TAP System capacity to 20 BCM/y.
5.1.5 Applicable Codes and Standards

Pipeline, compressor and block valve stations shall be designed to European codes, except where specific equipment is designed to other standards nominated in the respective functional specifications. Design and construction of civil engineering structures and buildings shall be according to National Codes, the Eurocodes and European Standards. Fire design and protection of structures shall be according to the International Building Code (IBC).

Project details will be further developed and defined in the next steps of the design.

5.1.6 Safety

A preliminary risk assessment of the pipeline route was performed with the aim of verifying the pipeline safety. The preliminary assessment determined that the route was feasible with respect to safety of the pipeline and the nearby population. In a few denser populated sections a potential for route optimisation was identified in order to further reduce proximities to settlements. Furthermore, the most populated sections identified are relatively short, enabling efficient technical risk mitigation to be applied where needed or required (Please refer also to Chapter 10).

5.2 Main Project Components

The TAP Project in Greece for the section Nea Messimvria – Greek-Albanian border consists of the following main components:

- Approximately 181 km pipeline;
- Approximately 8 Block Valve Stations (depending on final layout);
- Compressor station CS02 for the 20 BCM expansion (optionally located in Greece depending on the results of further system studies);
- Associated facilities required during construction (access roads, camps, yards, etc.).

5.2.1 Pipeline

The buried cross-country pipeline from the start (BVS) near Nea Messimvria to the Albanian border is approximately 181 km in length and has a diameter of 48''.
The pipeline will be designed according to Standard EN 1594 (Pipelines for Maximum Operating Pressure over 16 bar – Functions Requirement). The pipeline will have the following design specification:

- Line pipe material: Steel Grade EN 10208 L485MB (or API equivalent X70).
- A 3-layer polyethylene-based coating.
- Cathodic protection system.

The minimum cover depth for the pipeline is 1 m in regular sections. Where needed the coverage will be more the increased (e.g. crossings or ecological sensitive sections)

5.2.2 Compressor Station

General features

Compressor stations are required to transport the gas by increasing the pressure.

The footprint required for the compressor station buildings is approximately 200,000 m². Due to the safety distances between equipment and processes, a larger site area will be required. At present the necessary minimum site area is estimated as approximately 410,000 m² (i.e. 41 ha). Additionally, there might be restrictions for land use in the near surrounding of the compressor station triggered by risk protection requirements. Safety distances shown within the station layout are based on engineer experience. They will be verified during the Quantitative Risk Assessment (QRA) process and may be adjusted according the results of the assessments.

A compressor station typically consists of: 1 – Pipe Inspection Gauges (Pig) traps; 2 – Filters; 3 – Fuel gas Treatment; 4 – Turbine-Compressor buildings; 5 – Gas coolers; 6 – Control building and 7 – Maintenance building & Warehouse (see figure 5-2).
Figure 5-2  Compressor Station - Typical Layout

Thus each compressor station will mainly comprise facilities for gas treatment (filter separators), metering, compression and cooling.

Filter separators will be used to clean the gas from deposits which might occur in the pipeline upstream of the metering runs. After cleaning and metering the gas will be compressed to the required pressure. For the pressure increase the installation of gas turbine driven turbo compressors is planned.

For CS02 that will be implemented in the 20 BCM case, 3 compressors of 15 MW ISO class and 4 compressors of 25 MW ISO class will be installed. During standard operation 1 x 15 MW ISO class and 1 x 25 MW ISO class compressor units will be on standby.

The fuel for the gas turbines is natural gas taken from the gas pipeline. Exhaust gas from each gas turbine will be discharged to the atmosphere via one dedicated stack per gas turbine each of approximately 30 m height. This means total 7 stacks for CS02. As a technological option, the installation of a combination of gas turbine and steam turbine driven turbo compressors is under investigation at present. In this case the lost heat from gas turbine driven compressors will be used to produce steam to operate one or more steam turbines connected to a turbo compressor for gas compression.
Further, a venting stack of approximately 70 m is envisaged through which natural gas can be released in the case of unplanned overpressure in the system. After compression the gas will be cooled down to 50 °C via air cooled heat exchangers. Filter separators, metering runs and gas coolers will be installed as free standing facilities, whereas the compressors and gas turbines are installed in buildings. Currently buildings each with two compressors separated by a wall are foreseen. Further additional buildings are required, such as control, electrical, workshop and administration buildings.

The compressor station(s) will be connected to external electrical power supply at medium voltage level. The electrical connection from the grid to the compressor station is not yet determined. Independently from this, each station will be equipped with a gas driven power generator to provide the power in case of loss of energy from the external source.

The water demand for drinking water and process water supply (on average about 1,200 l/day) will be covered from groundwater wells that will be located within the Compressor Station site.

_layout_

The current layout generally presents the overall sizes and arrangement of the proposed buildings, infrastructure and plant equipment which will be required 20 BCM case. This will probably require revision after further consideration of site constraints during detailed design. An indicative layout of CS02 is presented in Annex I.

Equipment is located outdoors wherever possible. The station area is separated into different main areas each with the aim to minimize number of potential hazard sources per area. Due consideration is given to the location and safety distances of process equipment, compressors and technical buildings as well as escape routes and safety equipment.

The compressor station including the space necessary for expansion is completely fenced to prevent unauthorised people entering the station.

The layout is designed in such a manner that the prevailing wind direction (North-West) carries from occupied areas to compressor buildings and gas piping area. The arrangement according to main wind direction and the large distances are also chosen to avoid interference of gas sources with ventilation systems.
Large distances between the main areas within the compressor station site are designed to allow safe operation and maintenance as well as emergency actions. It also ensures that one device does not cause safety-related malfunctions to another. In particular, adequate separation between flammable hydrocarbon containing equipment and ignition sources and adequate separation between hydrocarbon handling areas and emergency services have been considered.

The overall supervision and remote control of pipeline and station operation will be done by the main control centre located in Italy. Nevertheless the local Control Room Building is located in a sufficient safety distance from compressor buildings and gas piping areas and additionally will be protected by the Electrical Building in front of it.

Occupied buildings like the administration building, workshop and gate house as well as the helicopter landing site are located at the main entrance of the plant and in a sufficient distance from compressor buildings and gas piping areas to fulfil all requirements of fire protection, safe evacuation and rescue operations.

The vent stack is located at the opposite end of the site and at a sufficient distance to occupied buildings to ensure minimum interference or hazard to plant and personnel.

**List of Buildings and Structures**

- Compressor buildings for units, each with related structure and installation like air intake, stack and oil cooler
- Electrical Building and Control Room Building
- Power Generation Building
- Fuel Gas Skid
- Utility Building
- Workshop/Stores Building
- Administration Building
- Gate House
- Maintenance Shelter Pipeline
- Garage
- Parking Area
• Petrol filling station
• Outdoor facilities including the vent stack, gas cooler and gas processing units, condensate tank, filter, scraper (PIG) launching and scraper receiving Station, skids, piping, valves etc.
• Cable ducts
• Access roads, internal roads and gravelled areas
• Rain/fire water retention pond
• Groundwater wells for water supply
• Collecting or treatment facility for sanitary wastewater
• Helicopter landing site
• Station fence

The layout also presents the required space needed for new buildings and installations in the expansion stage:
• Compressor Buildings for further units each with related structure and installation like air intake, stack and oil cooler
• Outdoor facilities including gas cooler and gas processing units, skids, piping, valves etc.

Building Design

The structure of the buildings shall be mainly in brickwork and prefabricated or in-situ concrete parts. Buildings will be mostly flat roofed. Visual and outside design aspects like wall materials and colours will be integrated in an architectural concept.

Infrastructure

Access to the compressor station CS02 is planned to be provided via the local road network. An existing secondary road (gravel path) will be upgraded to access road for compressor station (width approximately 6.5 m). Two independent access roads will be provided to surround all the process equipment forming a ring and connecting traffic areas. These roads provide within the compressor station adequate access for fire brigade and ambulance to all plant areas and opportunity for personnel escape from all process areas
and buildings to pre-defined assembly points. The roads within the station are designed as asphalt or pavement (width approximately 6.0 m).

5.2.3 Block Valve Stations

To enhance pipeline safety, for the pipeline section in Greece 8 block valve stations are planned (1 at the start and 7 on-route to the Albanian border). With these block valves the operator can isolate any segment of the line for maintenance work or isolate a rupture or leak. The block valve stations are unmanned and contain a small building with a fence around them to avoid any interference, covering a total surface area of approximately 20x30m. In line with international best practice, these stations will be installed in regular intervals of around 30 km and the main equipment of such station will be installed underground.

5.2.4 Special Facilities

Leak Detection System

The pipeline will be monitored by a leak detection system that operates on the basis of flow, pressure and temperature monitoring, thereby detecting losses on an automatic basis. Undetected leaks are now a rare occurrence in modern pipelines as leak detection systems allow immediate notification and action in an emergency.

Corrosion Protection - Corrosion Monitoring

The pipeline will be made of welded steel pipe sections which will range between 8 and 18 m in length. The steel pipe sections will be coated both inside and outside. The internal coating will be an epoxy resin which reduces friction, whilst the external coating will be 3-layer polyethylene to protect the pipeline from corrosion. Some of the pipeline sections will be additionally coated with reinforced concrete to protect the pipe from external damages, but mainly to avoid buoyancy. The entire pipeline will be protected against corrosion by a cathodic protection system.
5.3 CONSTRUCTION PHASE

For the main components described above the construction phase is described in the following sections except the construction of the compressor station that is included in Section 5.3.4.

5.3.1 Pipeline Construction

General Features of Pipeline Construction

The pipeline will be buried underground for the entire length. For safety reasons and in order to minimise impacts to existing land uses (e.g. agricultural) the buried pipeline will have a soil cover of minimum 1 m. Greater depth will be required when crossing existing infrastructure. A typical cross section that shows the pipeline buried in its trench is provided in Figure 5-3.

Figure 5-3 Indicative Cross Section of the Pipeline and Trench

The pipeline will be assembled in a conventional way with a construction spread that moves along the pipeline corridor. First, the top soil is stripped away and stored separately, and then a trench is excavated. Individual 8 to
18 m long joints of pipe are then welded to the pipeline string which is subsequently lowered into the trench. For communication and data exchange during operation, a fibre optic cable will be laid alongside the pipeline within the pipeline trench. The soil is placed back into the trench and the land reinstated while the construction spread moves forward.

In flat soft terrain the average construction progress will be up to 600 m/day, in hilly or mountainous regions the average progress will be between 300 and 450 m/day whilst in difficult sections like steep slopes and rock the average progress could be as low as 50 m/day.

Specialised techniques will be used for crossing of roads and railways. The crossing of main roads/highways, railways and larger channels may require the use of trenchless methods (e.g. horizontal drilling). Whether performing an open-cut or a trenchless installation, the pipeline shall be installed at least 2-3 m below the existing infrastructure to be crossed.

The standard pipeline construction, applicable along most parts of the TAP in Greece, has the following main characteristics:

- The width of the working strip must provide room for pipeline fabrication (pipe stringing and welding, protective coating and quality testing of the fabricated pipeline section, lowering into the trench), and for simultaneous vehicle movements, both to happen in a safe manner. The working strip requires a width of approximately 38 m. A typical working strip cross section is provided in Figure 5.4.

- The fertile top soil (typically 0.3-0.5 m thick) will be stripped off over a width approximately 22-24 m. The top soil is temporarily stored on one end of the working strip.

- The non-fertile “sub-soil” obtained from the pipeline trench excavation will be stored on the opposite side of the working strip. Fertile top soil will be re-deposited on top of the non-fertile soil for reinstatement to assure adequate crop- or vegetation growth.

In areas where there are construction constraints (e.g. environmental or land use constraints) and in general where limited space is available, the working strip may be reduced from 38 m to 28 m (see Figure 5-5).
Figure 5-4  Standard Working Strip

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Figure 5-5  Reduced Working Strip
The main limitations on future land use during the entire project life cycle will be:

- A narrow corridor of maximum 8 m width (referred to as the Safety Strip) in which the growing of deep rooting plants, such as trees will be restricted,
- A corridor of maximum 60 m width in which the construction of houses will be restricted, and
- A corridor of maximum 200 m width in which the establishment of new organised settlement structures (local area plans) and/or industrial infrastructure will be limited.

The preferred route was selected to accommodate these criteria and allows sufficient buffer space also for future developments of neighbouring communities passed by the route.

The pipeline route in Greece crosses one highway, seven major roads, 30 secondary roads, 228 unclassified roads and tracks and one railroad line. In addition, it requires 30 river crossings, including 14 major rivers. Where necessary, construction methods that avoid interferences or visible long term impacts will be used for crossings in order to minimise impacts on traffic and the environment.

*Construction activities for Onshore Pipelines*

Several construction lots will make up each construction spread, with the work proceeding generally in the following sequence:

- Surveying; Right-of-Way marking and clearance
- Topsoil stripping;
- Grading;
- Pipe stringing;
- Bending;
- Pipe line-up;
- Pipe welding;
- Joint Testing (X-Ray and Ultra sonic);
- Weld Repair (if needed);
- Joint Coating;
- Trenching (i.e. digging of the trench)
- Pipe lowering-in;
- As-built surveying;
- Bedding and backfill partially;
- Backfill;
- Tie-in;
- Road, railway, river, stream and canal crossings;
- Block Valves (BV) installation;
- Cathodic Protection;
- Pipe Cleaning and Hydrostatic testing and drying;
- Interior inspection by intelligent Pipeline Integrity Gauge (PIG) run; and
- Cleanup, Restoration and Re-vegetation of construction strip and other sites

The above steps are explained in more detail in the following:

Surveying

Prior to any construction, the route will be surveyed and the proposed centreline will be staked out. The outer boundaries of the construction corridor will also be staked out. Generally, the proposed centre line of the pipeline will not be in the centre of the construction right-of-way, but will be offset to one side. The overburden (excavated material) will be placed on the narrow side of the construction corridor. On the wider side, provision will be made for two vehicles to pass as well as a work area for stringing, welding, laying, coating and testing the pipe. The limits for clearing will be clearly marked. An environmental specialist will accompany the survey crews to clearly mark/flag sensitive environmental and archaeological sites.

Marking and clearance of Working Strip

The width of the area required for pipeline construction (also referred to as the working strip/corridor) will vary according to site-specific conditions. In general, the construction strip (including the safety strip) will be 38 m wide (see figure 5.2.1b). Preparation of the working strip will consist of clearing and grading. The working strip clearing will include removal of all structures, trees, bush, crops and boulders within the working strip made available by the owner. Tree stumps and roots in the trench that will interfere with operation of the trenching machine will also be removed.
Top Soil Stripping

The top soil will be removed within the width of the working strip carefully trying not to demolish the structure of the top-soil using excavators with flat and 2 m/3 m wide buckets to lift off the topsoil and store it on the side of the working strip.

If long term storage of topsoil is required than the soil heaps will be seeded with deep rooting plants for protection.

Grading

Typically the working corridor is graded by equipment such as bulldozers and motor graders to the width needed for construction in order to furnish efficient working space for all the crews that will follow. The working corridor will prepared more or less like and unpaved road. However, the grading will be less than that needed for a road as construction equipment can negotiate steeper and more uneven terrain than passenger vehicles. The cuts in the graded areas will be kept to a minimum to facilitate restoration of the corridor after the completion of the construction period.

Pipe Stringing

Pipe stringing normally occurs concurrently with trenching. In some cases, pipe stringing precedes trenching. Pre-coated (corrosion protected), 48” pipes will be hauled to the right-of-way on stringing trucks. The pipe will be unloaded from the trucks with a mounted crane, single crane or side boom and placed end-to-end alongside the future trench taking special care of the bevelled pipe joint ends. Where river and road crossings are to be accomplished, the appropriate pipe will be stockpiled on that side of the crossing where the construction crews execute the cross-section. Depending on access and terrain, the trucks will off-load the pipe and then directly return to the pipe lay-down area. In cases where there is a narrow construction corridor, the trucks will have to make a continuous loop by driving a significant distance up the corridor, off-load the pipe, and follow the corridor a significant distance to exit. If access is very limited, pipe will be hauled up the corridor by tractor and trailer and unloaded along the trench line.

Bending

Before the pipe is prepared for welding, a bending crew will bend the pipe in place where necessary to match the contours of the terrain. The crew will use
a hydraulic bending machine to put gradual bends in the pipe. The bending will be limited to making many small bends along the length of a pipe section until the desired bend angle is obtained. The pipeline centreline will be surveyed with bending limitations in mind. Where the bend cannot be made gradually enough to meet specific conditions, a preformed factory bend will be inserted into the pipeline. These conditions will be identified prior to construction.

Pipe welding and joint testing

The welding crew is the largest workforce crew. The crew will consist of a number of welders using automatic welding machines or semi-automatic welding machines mounted on paywelders and/or tractors. The weld will consist of several passes depending on the wall thickness of the pipe. All welders that work on a joint have unique identifying codes. The codes are marked on the area adjacent to the pipe so complete records of the welding will be maintained.

Joint Testing

Shortly after the welding crew has passed, an independent NDT-crew (Non-Destructive Testing) will test the welds. Each weld made during construction is inspected by NDT (radiography or ultrasonic testing). All of the test records are examined by an independent test engineer (certified according to ASTM Level II) and evaluated according to API 1104 for welding flaws or pipe defects. The NDT test results will also be reviewed by the TAP welding inspectors as an additional level of quality control. Any test results of questionable quality are retaken. Any welds indicating defects will be flagged for repair or cut-out.

Joint Coating

After the welds have been checked and tested, the coating crew will clean the exposed steel section at the joint between the pipes, sand-blast the steel to remove mill scale, rust and foreign particles and apply a protective coating to it. The coating will be a heat-shrinkable polyethylene sleeves around the pipe. Heat will be applied to the coating material to shrink it around the joints and form a tight, impervious covering on the joints. After the joints have been coated, an inspection crew will check the pipe for nicks and abrasions in the coating with a high-voltage testing device (Holiday-d detector). Chips or abrasions in the coating will sound an alarm on the test equipment and the
crew will place a mark on the pipe to indicate the defect. Repair crews will patch the defects prior to lowering the pipe into the ditch.

Trenching

The pipeline trench will be dug to a minimum depth of 2.3 m below ground surface. The width of the trench at the base will be a minimum of about 1.5 m and at the ground surface this will be between 4 – 7 m depending on soil conditions.

The trenching will be done by excavators. Extra ditch depth will be excavated if needed to accommodate the transition of the pipeline at the bottoms and tops of hills, river crossings, road crossings, and railroad crossings. Several excavators will be employed at the same time.

Generally rock will be dug out using a jack-hammer; however, if blasting is required, the charges will be shaped to limit the amount of outward explosion. To limit the amount of debris spread, heavy mats are placed over the charges. These mats also reduce the level of noise from the blast itself.

It is possible that dewatering of the trench maybe required if the ground is very wet. Water will be directed to streams, rivers or irrigation ditches and this will be undertaken in agreement with the relevant authorities.

Pipe Lowering In

The pipe will be raised off the skids and lowered into the trench by a team of side boom operators. All rock will be removed from the trench prior to the lowering-in operation. It will be ensured that in any case only stone-free material will be used for bedding the pipe sections. In areas of rocky terrain, sand or sieved backfill material will be placed in the bottom of the trench and on both sides of the pipe for protection purposes. If necessary, heavy duty plastic mesh (rock-shield) will be wrapped around the pipe in rocky areas to protect the pipe and coating from damage during the lowering process. Before the pipe section is laid down on the trench bottom detection test of the insulation will take place again; after the pipe is laid in the trench the wooden skids or sand bags are picked up and moved ahead for the line up crew to reuse. All other debris is removed from the site and the trench is inspected to ensure that no debris has fallen into the trench.
As Built Surveying

The top of the pipeline is surveyed and recorded after lowering-in and before start of back-filling. With this survey “As Built Drawings” will be prepared for the final documentation.

Backfill

Backfill will normally be placed over the pipeline immediately after the pipe section has been lowered into the trench and was surveyed. The backfilled material will be compacted in layers. Bulldozers will be used to push stockpiled materials removed from the ditch back into the ditch to cover the pipe. In areas that contain large quantities of rock, selected fill material may be imported to put the first layer of cover over the pipe, or special padding machines may be brought in to sieve the rock from the backfill before the latter is used for backfill. Extreme care will be taken with the initial fill to avoid damage to the coating during backfill. After the initial layer of screened material is placed on the pipe, the remaining soil and rock mixture will be returned to the open ditch to complete the backfill.

Tie in

In order to tie pipe strings together, the backfilling crew will leave a significant portion of the end of the pipe string exposed. The second string is lowered into the trench so that it overlaps the backfilled pipe. The ends of the pipe are lifted, cut to fit, re-bevelled, externally clamped in position, and then welded together. The welds are NDT tested while still exposed and then coated after being accepted by the test engineer. After this, backfill of the Tie in can be completed.

Road, Railway and River Crossings

The pipeline will cross many areas requiring specialized construction methods. Crossings will be installed in parallel with or in front of the mainline construction spread. This will be done by separate crews that will perform the excavation, boring or ditching, welding, and installation of the crossing pipe. All pipeline joints at crossings will be NDT tested.

In general the following methods will be applied depending on the local conditions and the characteristics of the structure that has to be crossed.
For crossing of roads mainly the open-cut method is used. To facilitate the open cut at the crossing location the traffic will be diverted around the crossing via detours or temporary roads. To minimize the duration of traffic disruption, the pipe will be prepared prior to commencement of roadway excavation. Once the pipeline has been in-stalled, the trench will be backfilled and compacted in layers in accordance with relevant agency specifications. The roadway will then be resurfaced over the compacted trench. Final selection of crossing methods will be coordinated with the appropriate road management authority.

The open cut method will also be applied as well to cross small water courses with only temporary or low run off and where no significant ecological constraint is present.

The Jack and Bore approach, as well as Horizontal Directional Drilling (HDD), facilitates crossings without interrupting the crossed structures during construction. Thus they will be applied where open cutting is not feasible due to traffic requirement (e.g. in case of highways and railroads) or ecological constraints.

The Jack and Bore approach requires the digging of a large starting pit on one side of the structure to be crossed. The boring machine will be lowered into the pit to begin boring, with the pipe inserted into the hole as it is being drilled. The outside of the pipe will be coated with abrasion resistant material to protect the pipe coating from scarring and nicking as it is pushed through the bore hole. As each complete joint of pipe is installed, the boring shaft will be separated and another joint of pipe welded to the first joint. The shaft will then be reconnected through the new section of pipe and the boring will continue. This method will continue until the boring head and the pipe is received in a "capture" pit on the opposite side of the crossing. Since the pipe used for boring will as well be used as carrier pipe, all welds will be NDT-tested as they are completed.

Horizontal Directional Drilling (HDD) may be employed for crossing in sensitive areas (e.g. sensitive ecology). Generally, the HDD is a trenchless crossing method and the HDD process begins with boring a small diameter, horizontal hole (pilot hole) under the crossing obstacle (e.g. a river) with a continuous string of steel drill rod. When the bore head and rod emerge on the opposite side of the crossing, a special cutter, called a back reamer, is attached and pulled back through the pilot hole. The reamer bores out the pilot hole so that
the pipe can be pulled through. The pipe is usually pulled through from the side of the crossing opposite the drill rig. Usually a drilling mud, such as fluid bentonite clay, is forced down the hole to stabilize the hole and remove soil cuttings. Drilling mud can be made from clay or polymers. The primary clay for drilling mud is sodium montmorillonite (bentonite). The Horizontal Directional Drilling mud reduces drilling torque, imparts lubrication to the pipe, provides annular flushing of the freshly cut borehole soil debris, and gives stability and support to the bored hole (see Figure 5-6 and Figure 5-7).

**Figure 5-6** Indicative Layout of HDD Site (drilling side)
The actual feasibility of the HDD method is subject to geotechnical conditions, e.g. if boulders or erratic rocks are in the underground, the method usually cannot be used since the drill would be obstructed by the obstacles.

The pipeline section at each major crossing will be hydrostatically tested, i.e. the tightness and integrity of the joints will be tested by filling the section with pressurised water. The whole pipeline will be tested after it is placed in the trench and backfilled, also in sections depending on the category and the longitudinal profile. The hydrostatic test is done by sealing the end of the pipe section, filling it with water, and applying pressure.

Increased burial depths at important crossings (roads, rivers, railways) and steep slopes will help maintaining the structural integrity of the pipeline.

**Block Valve Installation**

A number of block valves will be installed along the pipeline route (currently under design). These valves will enable sections of the pipeline to be isolated.
in case of breaches of the pipeline's integrity and will serve to limit the magnitude of any product release. All of the block valves between the compressor stations and delivery facilities will be weld end valves, and buried below ground. Weld end valves are less susceptible to leaks than flanged valves. Integrity of the valves is also monitored by the pipeline Leak Detection System.

**Cathodic Protection Installation**

An impressed current cathodic protection system will be installed to protect the pipeline from corrosion. The cathodic system components and locations along the alignment will be determined during detail design and engineering studies. The system comprises anodes (reactive metal) that are buried in the soil along the pipeline. These anodes are interconnected to one pole a DC-source. The other pole of the DC-source is connected to the pipeline at so called test points. This creates a galvanic circuit that provides the necessary protection of the pipeline against corrosion. The test points for the cathodic protection system are installed at approximately 2 km intervals by the backfill crew.

**Clean Up and Restoration**

After completion of backfill of a given length of the pipeline, the restoration operation will begin. The removed top soil will be placed back on the working strip. The original contours of the land will be restored as closely as possible. As part of the restoration process, all equipment access crossings will be removed as well. The banks of rivers will be stabilized where necessary, and restored, and progressive rehabilitation will take place with the aim to return the area to its pre-disturbed nature.

Any damages including those to drainage or irrigation system will be fixed in agreement with the owner; same applies to damages on public roads or agricultural tracks.

**Pipeline marking**

Pipeline markers and aerial markers will be installed along the route to show the location of the pipeline and identify the owner of the pipeline to contact the owner regarding activities that may affect the pipeline. In addition, warning tape will be laid above the pipeline in the trench.
5.3.2 Construction of Compressor Station CS02

The following construction steps are, usually, recognized in such facilities:

- Surveying;
- Preparation of temporary facilities such as storage areas, offices and accommodation facilities;
- Preparation of the construction site;
- Earthworks;
- Preparation of foundations;
- Erection of equipments and buildings;
- Laying of cables, electrical works;
- Piping and mechanical works;
- Construction of internal roads and areas (if any);
- Installation of operational and instrumentation systems;
- Commissioning; and
- Operation.

5.3.3 Auxiliary Construction Facilities

Except the hook-up to the medium voltage electricity grid, no external facilities are permanently required.

During construction a number of temporary facilities will be required: For the storage and handling during construction, TAP will need 6 temporary stock yards for the pipes (pipe yards) and 3 worker camps (see Annex I – Map 1). The selection of the location of associated facilities was conducted on the basis of access to the construction sites and working strip. An additional desktop assessment of the environmental, socioeconomic and cultural heritage impacts of the sites and roads was performed with the aim to choose locations with minimise interferences.

Pipe yards sizes will range between 15,000 m² - 24,000 m² with capacities ranging between 1200 – 2800 pipes. Regular pipes of diameter 48” will be stacked in three layers, concrete coated pipes (e.g. for river crossings) will be stacked in two layers maximum.
Workers camps will range between 20,000 m² (200 x 100 m) and 50,000 m² (200 x 250 m) and will accommodate between 80 and 200 workers. The pipe yards and workers camps are expected to be operating for approximately 1 year during the construction phase.

5.3.4 Construction Traffic

Construction traffic will to the extend possible utilise the existing local road network to access points along the working strip but several temporary or permanent access roads may be required (subject to more detailed construction logistics studies). Traffic will then travel up and down the construction strip. Construction materials such as pre-fabricated pipe joints will be stored at established pipe storage yards which will be located as per agreement with the relevant land owners and/or municipalities. Materials will then be transported on heavy goods vehicles from these locations to the workings strip. Materials for civil construction will temporary stored within the working strip A Traffic Management Plan will be developed in consultation with the competent authorities and municipalities, and implemented throughout construction.

5.3.5 Local Content during Construction Phase

TAP has developed a Local Content Strategy with the aim of maximising local employment and procurement by TAP and its subcontractors. Where possible, goods and services will be procured locally, and while complying with TAP’s procurement guidelines. In addition, as part of its Corporate Social Responsibility (CSR) Policy, TAP will support capacity-building initiatives to improve relevant skills and invest in local enterprises to provide skills and expertise up to international best-practice standards. All hiring and procurement will be carried out through transparent bidding and tender processes.
5.4 Commissioning and Operation Phase

5.4.1 Pipeline-testing

Once the pipeline has been installed a number of activities will be required to ensure that the pipe meets the operational requirements. The primary objective of these activities is to verify that the line has been laid without significant defects and that it is in a suitable condition to be filled and pressurised with the export gas. The pre-commissioning equipment will be used for cleaning, hydrotesting and gauge pigging of the installed pipeline. The equipment will be mainly located at the block valve stations, so that it can be used to pre-commission the pipeline in sections.

The water required for hydrotesting shall be fresh and clean water which will be drawn from (and discharged to) water sources along the route (rivers, reservoirs, lakes) as far as it is tested and complies with the relevant regulations. A concept and assessment for the proposed hydrotesting activities and water resources to be used will be defined in detail in the ESIA based on detailed studies. The maximum length of a test section shall be limited to 10 km horizontal. Special sections such as main river crossings shall be tested individually.

5.4.2 Commissioning

During the commissioning phase test operation of the pipeline system will be performed to assure the overall functionality and proper performance of the system and its single components.

5.4.3 Operation

Detailed operating procedures for the pipeline system will be developed. These procedures will be in place ahead of pipeline operation. The operating procedures will typically address the following:

- An administration system covering legal considerations, work control and safety;
- Clear and effective emergency procedures and operating instructions;
- Adequate and regular training of all personnel involved in operational and maintenance issues;
• A comprehensive system for monitoring, recording and continually evaluating the condition of the pipeline and auxiliary equipment;
• A system to control all development or work in the vicinity of the pipeline;
• Effective corrosion control and monitoring;
• A system to collect and collate information on third party activities;
• Monitoring of restoration, and the undertaking of remedial work as necessary.

The pipeline will be monitored and controlled from a central control room at a location yet to be confirmed. The monitoring system is a SCADA System (System Control and Data Acquisition). During operation, leak detection will be by continuous measurements of pressure and flow rates at inlet and outlet of the stations and pipeline. If a leak is detected, shutdown will be activated. To allow internal inspection, pigging facilities will be installed. The pipeline system has been designed to allow use of instrumented pigs, if necessary.

5.4.4 Maintenance

The pipeline system will be monitored and maintained to ensure that the system, as designed, constructed and tested, remains "fit for purpose" throughout the design life as well as minimising environmental and human risk. In general, pipeline surveillance, function checks and condition monitoring will be used to anticipate system problems and allow them to be rectified in a timely manner. Planned maintenance management will be implemented through a combination of modern management techniques, information technology and innovative engineering technical analysis with the aim of minimizing any risks associated with long-term plant and equipment operations. The incorporation of planned maintenance has been a fundamental element of the project development to date and it will be implemented throughout the operation of the pipeline system.

Pipeline inspection and maintenance activities during operation will include the following tasks:
• Pipeline monitoring;
• Route surveillance possibly with road vehicles and helicopters;
• Special crossing inspections;
• Monitoring of population and third-party activities in close proximity to the pipeline;
• Cathodic protection (CP) system monitoring;
• Inventory monitoring surveys;
• Functional operational checks and verification of plant and equipment; and
• Routine maintenance of plant and equipment at pre-defined intervals.

Intelligent pigging of the pipeline will be undertaken on a regular basis to confirm the geometry of the pipeline, and in addition following suspected damage or a seismic event.

5.4.5 Use of energy, water and of raw materials

Electrical Power consumption of the compressor station is approximately 2,000 kW with medium voltage.

Since the proposed compressor station site(s) is located in open space at some distance from settlements, there is no reasonable access to the local water supply infrastructure station. Therefore it is foreseen to cover the drinking and process water demand (on average about 1,200 l/day) by groundwater wells that will be installed within the compressor station site. Details on the required quantities will be available at later stage.

Rain water from roofs and paved areas (buildings/ roads) shall be collected in sewerage system and stored in a pond for re-usage (i.e. for fire water supply). Rain water not being re-used shall be discharged in nearby creek located east of the site according to requirements of responsible authorities. As an alternative option the rainwater might be infiltrated in substratum.

Raw materials will not be needed for the operation of the compressor station.

The block valve stations will need electrical supply. This can be covered from the grid or via solar panels depending on local conditions.
5.5 DECOMMISSIONING

Life cycle is planned to be 50 years for pipeline and block valve stations and 25 years for compressor stations and equipment. Decommissioning of the pipeline will be undertaken in accordance with the legislation prevailing at that time, in liaison with the relevant regulatory authorities. The eventual decommissioning requirements will be taken into account in the design stage by ensuring that all possible options will be available. The pipeline will carry only processed gas and therefore it is unlikely that the disposal of spent cleaning fluid will be of concern.

5.6 EMISSIONS OF THE PROJECT

5.6.1 Emission of air pollutants

During construction air emissions of air pollutants will result from the operation of construction machinery and transportation vehicles along the pipeline route. These emissions will be limited to the time of construction at the distinctive pipeline spreads.

During operation air polluting emissions will mainly result from the operation of the gas turbines of the compressor station during the 20 BCM phase. The flue gas will be emitted via stacks with a height of about 30 m.

5.6.2 Noise

Noise emissions will be generated temporarily during the construction phase in the single spreads and along access roads caused by construction machines and transportation traffic.

During Project operation only the compressor station operation constitutes a relevant noise source. Noise levels during construction and operation, both for occupational at site, and ambient at nearest sensitive receivers, will comply with the appropriate international and national standards.
5.6.3 Other Nuisance

During construction there may be some nuisance related to vibration generated, particularly during any piling or blasting. Dust may also represent a temporary nuisance. However, this is a non-issue during operation of the Project.

Other forms of nuisance associated with domestic waste/refuse (e.g. vermin) will be avoided by appropriate waste management measures.

5.6.4 Waste Generation/Waste Management

To cope with the waste resulting from construction and operation a Waste Management Strategy will be developed for the Project to cover construction, testing, commissioning and operation.

The Waste Management Strategy will:

- Propose a minimisation/ collection/ storage/ treatment/ re-use/ disposal route for each waste stream;
- Identify potential third party re-users;
- Describe locations of landfills or long-term storage sites for waste;
- State the method to properly manage (i.e. training, storing, containerising, labelling, transporting, disposing) wastes; and
- Describe the transition of control from the construction contractor to the operator, including arrangements for adequate and compliant commissioning and depositing of waste.

The main quantity of materials during construction potentially to be disposed of is the excavated material from trenching activities. The total excavated material for the whole length of the pipeline amounts to approximately 1,000,000 m³. The largest part of this material however, in particular soil, will be used for back-filling the trench after installing the pipeline in place. Rocky material will be disposed of at suitable sites in consultation with the regional authorities.

Waste from the construction sites comprises used tyres, spare parts and wood or packaging material. All such waste will be either sent for recycling or disposed of at appropriate landfill sites in consultation with the authorities.
During operation small amount of waste will be generated at the compressor station resulting from maintenance work and from workers on the site.

5.6.5 Wastewater Discharge

The principal types of wastewater generated during construction and commissioning will be:

- Wastewater arising from construction camps
- Hydrotesting water discharges.

In addition, wastewater will be generated by subsidiary operations, such as vehicle and equipment washing. Wastewater will be minimised wherever possible by the efficient use of water and water management schemes will be devised for both construction and operational phases. In order to minimise waste, the management schemes will aim to ensure that water is re-used whenever practicable prior to treatment and disposal, e.g. grey water (excluding greasy kitchen water) will be used for dust suppression. All camp wastewater, including septage will be collected in holding tanks and will be removed from site by tanker for treatment at a municipality approved treatment facility.

Fresh and clean water is planned to be used as hydrotest water. Depending on its bacterial quality, it may need to be treated with chemical additives, although this has not been necessary in previous pipeline projects in Greece. In addition, oxygen scavengers may need to be added. Hydrotesting will be undertaken section after section and the same water will be filtered and recycled for reuse wherever possible. Quantities of water necessary for hydrotesting depend on the length of the section, but for a typical section of 10 km, the required quantity would be in the order of 11,000 m³. Hydrotest water that is not longer fit for re-use or no longer needed, will be discharged according to its chemical properties based on approval of relevant authority.

During operation sanitary wastewater will only occur at the compressor station site. A small waste water treatment plant (WWTP) will be installed in the compressor station area if no connection to an existing public sewer system exists. The discharges from the wastewater treatment plant will be tested and released to water courses according to the legislative requirements or will be disposed of by an authorized contractor.
6 IDENTIFICATION AND ASSESSMENT OF ALTERNATIVES

6.1 INTRODUCTION

The TAP Project offers a realistic opportunity in the form of an alternative transportation route which will open the Southern Gas Corridor\(^1\). It will be the shortest gas transit route of all the European pipeline projects currently being supported by the EU within the Southern Corridor.

Energy politics are becoming increasingly important nowadays, particularly in South-eastern Europe which lacks significant oil and gas resources and is traditionally dependent on imports. Although the TAP is a transit pipeline, i.e. designed to transfer gas to Western Europe through the host countries, the fact that a significant part of the pipeline crosses Greek territory, apart from the apparent financial benefits (in terms of transit fees), also strengthens the role of the country as an energy player in the region.

In addition, the fact that TAP AG foresees potential take-off points close to Kastoria, Ptolemaida and Florina, creates a future prospect to supply gas to western Greece, with obvious benefits to regional development. The Project also includes the option to develop natural gas storage facilities in Albania, which in turn will further contribute to increasing the security of supply in southeast Europe. The TAP’s path from Greece through Albania will enable nations in Europe’s southeast to be supplied with the natural gas they urgently need, thereby making a considerable contribution to the region’s economic development and political stability.

Following sections present the alternatives that have been considered by TAP AG for the pipeline routing and siting of facilities.

6.2 METHODOLOGY OF ALTERNATIVES APPRAISAL PROCESS

TAP AG adopted a ‘narrowing process’ starting from a study area approximately 181 km long and approximately 50 km wide centred around the

\(^1\) The ‘Southern Gas Corridor’ is a term used by the European Commission to describe planned infrastructure projects bringing gas from the Caspian and Middle Eastern sources to Europe, aimed at improving security of supply. The TAP Project supports Europe in achieving its strategic goal of securing further gas supplies and meeting gPPSPPSIng energy needs.
direct line between Nea Mesimvria to the designated border crossing point (see Figure 6-1). The narrowing process was performed with the aim to avoid or minimise interactions with the main environmental, social and cultural heritage constraints namely: protected areas, settlements and known cultural heritage sites. As a result of this process a total of four route main alternatives were identified (Alternatives N₁, N₂, S₀ and S₁ – see Annex I, Map 1).

![Figure 6-1 Initial 50 km Corridor Study Area](Image)

The technical, environmental, socioeconomic and cultural heritage baseline characterisation and appraisal of the four alternatives was then conducted through a combination of desk top studies and field surveys. For each alternative a 2 km wide corridor (1 km either sides of the proposed centreline route) was investigated, with the exception of a number of socioeconomic factors that required consideration on a broader scale.

Once the technical, environmental, socioeconomic and cultural heritage characteristics of each alternative were established, ‘impact indicators’ for
each discipline were used to highlight key features that could be related to the potential impacts of a standard gas pipeline project and also on the specificities of the study area (i.e. based on the findings of the desk study and field survey). The use of these indicators ultimately allowed the comparison and identification of relevant differences and similarities between the alternative routes being considered.

6.3 COMPONENTS OF THE ALTERNATIVES APPRAISAL

The outcome of the interdisciplinary alternatives appraisal in Greece led to the identification of two main corridors referred to as the ‘northern’ and ‘southern’ corridors. For each corridor a number of sub alternatives and local re-routings were identified. The appraisal led to the selection of two preferred alternatives for which the main environmental, socioeconomic and cultural heritage aspects were identified and compared.

The alternatives appraisal undertaken for both alternative routes (Base Case Base Case route and Alternative S0) followed the same principles:

- The appraisal was based on a number of numerical indicators derived from the GIS layers to ensure the comparison between alternatives in each region was clear to the reader.
- The relevance of each indicator was dependant on the element being analysed and on the result of the calculation.
- The appraisal produced the most favourable route based on the baseline findings and indicators.

According to the relevant discipline, separate indicators have been produced:

- Ecology: indicators cover flora, fauna, protected species, protected areas and landscape
- Cultural heritage: indicators rely primarily on measures associated with known sites and are dependent on numbers of archaeological sites and monuments.
- Socioeconomics: indicators cover demographics and settlements, local economy, livelihoods and land use.
A full list and description of these indicators is presented in Section 4.3. The full list of the indicators was used for the characterisation of the Study Area of the Base Case route. A sub-set of representative indicators has been selected for the purpose of this alternatives assessment.

Based on the procedure described above, all the alternatives have been identified and the following feasible alternatives, according to TAP AG’s criteria, were taken forward for more detailed discussion:

- the Base Case Route (as described in Chapter 4); and
- the $S_0$ Alternative Route (as described in Section 6.4 below).

### 6.4 DESCRIPTION OF BASELINE CHARACTERISTICS OF $S_0$

#### 6.4.1 Introduction

The baseline description of the Base Case pipeline route has previously been provided in Section 4. A description of the environmental, cultural heritage and socioeconomic baseline characteristics of the Alternative $S_0$ route is presented in the following Section.

#### 6.4.2 Environment

*Flora and Vegetation*

The Alternative $S_0$ passes through several types of habitats, i.e broadleaved forests, rivers, evergreen and mixed evergreen and deciduous shrubland, grasslands, meadows, pastures, agricultural land and urban areas.

The routing crosses mainly agricultural land (and plantations). Non-agricultural and non-urbanised areas (thus comprising mainly meadows-pastures, forests and wetlands) to be cleared cover a surface of about 23% of the whole area expected to be impacted during pipeline construction. Agricultural land is dominant along the $S_0$ route with the most extensive cultivated areas occurring along the eastern section of the route, on the Thessaloniki-Giannitsa plain.

The forest in the Study Area predominantly consists of broadleaved species, notably *Fagus*, *Quercus* and/or *Castanea*, with a total area of approx. 35 ha within the Working Strip. The most extensive broadleaved forests along the route are found on the southern and south-eastern slopes of Vermio Mountain.
Quercus is the most prevalent tree species in these areas, covering approx. 30 ha, while the Fagus and Castanea species occupy much smaller proportions. No coniferous forests are encountered on the S5 Alternative route corridor.

Montane and subalpine grasslands, meadows and pastures are found in the Study Area. These habitats are interspersed along several sections of the corridor, although a notable area can be found on the southern slopes of Vermio Mountain which hosts several species of conservation interest. Interesting species that have been recorded within the 2 km Study Area corridor during the field surveys are the Balkan endemic Colchicum doerfleri and the Greek-Anatolian endemic Thymus leucotrichus.

Although current cartographic data imply that wetland (riparian) habitats cover a small area\(^1\) along the S5 route, it was confirmed during fieldwork that small stands and remnant riparian forest also exist at several other smaller tributaries and rivers along the 2 km wide corridor. Riparian stands of conservation interest traversed by the route consist of Platanus orientalis forests and the Salix and Populus species.

West of Mount Vermio approximately twenty-one permanent watercourses will be crossed, including crossing Aliakmonas River twice (west of Pentavryso and north of Neapoli) and crossing a few of the downstream sections of the main tributaries of Aliakmonas. At least eight crossings are expected to affect tributaries within the Aliakmonas valley between Siatista and Votani.

With the exception of Lianovrochi stream in the vicinity of Veroia and a crossing of River Axios, there are no crossings of permanent watercourses east of Mount Vermio. However, many irrigation channels or heavily modified rivers such as Loudias are crossed.

The serpentine areas, a habitat hosting numerous endemic plant species, cover a significant part of the Study Area.

\(^1\) within the Axios valley and Thessaloniki – Gianitsa plateau, the second involving mainly irrigation channels
Fauna

Regarding mammal species, the route crosses the Thessaloniki – Giannitsa plain which is reported to host colonies of the internationally protected European ground squirrel (*Spermophilus citellus*): it is under investigation whether colonies do exist within the Working Strip or even in or within vicinity to the 2km corridor. The species is also reported in the Axios Valley and the area surrounding Kozani.

BPPSn bear (*Ursus arctos*), either as vagrant or as breeding individuals, has been recorded at almost all mountainous sites above 200m a.s.l. within the Project area except on the Eordea plateau which covers approximately 40% of the S0 corridor.

Two Important Bird Areas (IBA) are traversed by the proposed route alternative:

1) River Axios. The importance of this IBA at the location where the crossing is expected is not high as it has been substantiated that all bird species of high conservation interest within this IBA are found further south, outside the 2 km corridor.

2) Mount Vourinos. The two species that serve as criteria\(^1\) to establish the importance of this site are *Falco biarmicus* and *Aquila heliaca*. The *Falco biarmicus* population in Greece has been estimated between 35 – 55 pairs; one pair might breed at the southeastern section of the particular IBA site. A breeding pair of *Aquila heliaca* might be present within this IBA site – an extremely rare species in Greece. During breeding, the principal habitat is open steppes and fields. Nests are made on large trees.

It is unlikely that the Working Strip will affect any of these bird species. Reports for the breeding habitat of *Falco biarmicus* refer to sections far outside the 2 km corridor whereas the area crossed does not have any of the characteristics considered typical for the breeding habitat of *Aquila heliaca* as the area crossed comprises a small valley with some cultivations where no large trees are found and where a major piece of infrastructure, the Egnatia Highway, has already been constructed and is now operating.

\(^1\) these criteria serve towards the designation of the IBA «GR51 Mount Vourinos» as an SPA (selection species)
All streams/ rivers of permanent flow crossed by the $S_0$ alternative are of potential ichthyological interest. In the case of the crossing of rivers Axios and Aliakmonas, their conservation value from an ichthyological point of view is confirmed from existing freshwater fish data of nearby sites.

**Protected Areas**

The $S_0$ route corridor passes through the following Natura 2000 sites:

- GR1220002 & GR1220010 while crossing river Axios
- GR1330002 while crossing MountVourinos. This Natura 2000 site comprises the IBA referring to Mount Vourinos (*Figure 6-2*).

It is estimated that the total length of Natura 2000 sites crossed by the $S_0$ alternative is about 2 km. Additionally the $S_0$ alternative passes at less than 1 km away from the Natura 2000 site GR 1210001 while crossing the southern slopes of Mount Vermio. The route also crosses the following wildlife refuges:

- Koutsohori;
- Kouti – Agios Eleftherios;
- Tservena – Vourinos.
**Figure 6-2** Alternative S0 route crossing the Mount Vourinos Natura 2000 site

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**Landscape and Visual**

A large section of the S0 Alternative runs through the plains of Thessaloniki-Giannitsa and Eordea region. This flat agricultural landscape has the highest capacity to absorb change caused through the pipeline construction. The mixed mosaic hilly landscape with agricultural land and stands of *Quercus* forest in the western edge of the routing close to the Greek-Albanian borders and the grasslands and pastures in the southern slopes of Vermio are expected to be of low sensitivity regarding disturbance.

A large part of the routing from the southern slopes of Vermio to Siatista settlement runs in parallel with the Egnatia highway in a landscape characterized by the presence of this infrastructure.

Forested areas, mainly occurring on the southern slopes of Vermio are the most sensitive areas in terms of landscape along the alternative, since the forest clearance is considered as a long-term effect with high visibility. The riparian forest containing old *Platanus orientalis* trees along the Lianovrochi
watercourse, as well as any riparian stands along the tributaries of Aliakmonas in the Aliakmonas Valley, are also very sensitive features in landscape and visual terms.

6.4.3 Geomorphological Description

Thessaloniki- Giannitsa Plain - Dovras

The S0 route crosses flat, slightly undulating terrain and one small island-like raised area to the south of Skydra City. No rugged, dissected landforms have to be traversed by the Alternative S0 within this section. The Alternative S0 ascends from the flat plains at Dovras into mountainous terrain of Vermio Mountains. The highest elevation reached, are at ~km 65.6 with ~860 masl in more undulating terrain of cretaceous rocks and at ~km 77,0 with highest elevation reaching 1500 masl. The morphology frequently changes between steeper up and downs of mountain ridges and smaller flat intramontaneous basins especially in the southwestern part of this terrain unit.

Florina – Ptolemais – Kozani basin Voskochori - Drepano

This terrain unit starts at the mountain foothills at Voskochori and the S0 route runs more or less parallel to the Egnatia Highway along the valley floor until the eastern foothills of Mount Askion.

Mount Askion Pass - Drepano - Xirolimni - Mikrokastro

Between ~km 105.0 and 110.0 this terrain unit consists of slightly undulating hills and then runs parallel to the Egnatia Highway along the main valley floor, mostly within intramontaneous flat basin fillings. Between ~135.5 and ~km140.0 the morphology is determined by undulating hilly terrain with incisions of small watercourse channels.

Quaternary deposits on top of Southeastern Molasse zone - Mikrokastro – Simantro

This unit, the Molasse zone, is charaterised by flat and undulating hills with deeper incisions of watercourse channels and basin fillings of quaternary terrace sediments. The terrain is predominately made up of gentle hills and ridges featuring wide crests.

Northwestern Molasse zone - Simantro - Ieropigi - Albanian border

Within this terrain unit the Alternative S0 runs south of the Aliakmonas River
within the undulating hills of the Molasse zone, crosses Aliakmonas River and then reenters the Molasse zone. The terrain is predominately made up of gentle hills and ridges featuring wide crests. Peak elevation along this undulating terrain unit is at 1068 m at the Albanian border. But most of the terrain crossed by the \( S_0 \) pipeline route lies below 1000 m in altitude.

6.4.4 Seismicity

No Holocene activity was confirmed during site visits. No Category A fault is expected to occur in the area of interest. Category B faults (that is, faults that may produce moderate to strong earthquakes, with surface displacements of a few centimetres to a couple of meters) are equally unlikely to occur, especially when talking about surficial displacements that exceed a few tens of cm. Most, if not all, of the detected Quaternary faults of the area fall in Category C.

6.4.5 Cultural Heritage

A total of 95 sites along the Alternative \( S_0 \) route were identified by a combination of desk and field study. Of these sites, 39 were identified by the desk study, and 56 were new finds identified for the first time during the field survey.

Cultural heritage sites identified along this alternative, date from Neolithic to Modern period. Types of sites included are: archaeological sites (ancient settlements, cemeteries, remains of ancient Via Egnatia, open areas with concentration of surface and surface scatters of pottery), monuments (old churches and chapels) and sites with intangible cultural heritage (ICH) value (traditional and contemporary bridges, contemporary churches, memorials, recreation areas, accident shrines). Table 6.1 lists the CH sites found within the 2 km corridor along the alternative.

Table 6-1 Areas of High Cultural Heritage Potential within \( S_0 \)

<table>
<thead>
<tr>
<th>N.</th>
<th>Area</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ayios Athanassios, Gefyra, Nea Chalkidona area</td>
<td>Although no known sites are close to the centreline in this section, the concentration of sites in the vicinity makes it an archaeologically sensitive area.</td>
</tr>
<tr>
<td>2</td>
<td>Nea Nikomedia area</td>
<td>Important prehistoric settlement close to the centreline. Additional archaeological sites are present in the area.</td>
</tr>
<tr>
<td>3</td>
<td>Argos Orestiko area</td>
<td>Important ancient centre archaeologically sensitive zone. Possibly some of the Argos Orestikon sites close to the</td>
</tr>
</tbody>
</table>
6.4.6 Socioeconomics

Demographics and Settlements

The Alternative S₀ route crosses the territory of 10 municipalities that includes approximately seven thousand people living within the 2-km corridor. Three of the 10 municipalities have no settlements located within the corridor. There are 52 settlements within the corridor and 63 settlements from which people are potentially using the land and resources within the corridor. There are no settlements within the 40 m working corridor for the Alternative S₀ route.

Land Use and Livelihoods

The alternative S₀ route passes through large areas of agricultural land at the eastern end of the route with areas of irrigated land and permanent crops. The route continues through large areas of agricultural land, including non-irrigated arable land. Areas with permanent crops are also crossed to a limited extent, i.e. a total area of 27 ha based on the 40 m Working Strip.

---

<table>
<thead>
<tr>
<th>N.</th>
<th>Area</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Kranochori-Pentavryssos- Avgi area</td>
<td>Concentration of archaeological sites. Archaeological excavation site close to the centreline.</td>
</tr>
<tr>
<td>5</td>
<td>Platania area</td>
<td>Churches near the centreline</td>
</tr>
<tr>
<td>6</td>
<td>Chimerino to Mikrokastro area</td>
<td>Concentration of arch. sites, many are close to the centreline</td>
</tr>
<tr>
<td>7</td>
<td>Ksioleimni area</td>
<td>Archaeological excavation site on the centre line.</td>
</tr>
<tr>
<td>8</td>
<td>Drepano , Tetralofo area</td>
<td>Concentration of archaeological. sites. Some are close to the centre line.</td>
</tr>
<tr>
<td>9</td>
<td>Koumaria area</td>
<td>Archaeologically sensitive area.</td>
</tr>
<tr>
<td>10</td>
<td>Trilofos area</td>
<td>Although the known archaeological sites are located outside the buffer, in the map provided by the 17th Ephorate the buffer coincides with the archaeological sensitive area.</td>
</tr>
<tr>
<td>11</td>
<td>Ammoudara area</td>
<td>Archaeological site close to the centreline.</td>
</tr>
<tr>
<td>12</td>
<td>Kremasto area</td>
<td>Graves and residues of Romanian occupation have been discovered 1 km south of the settlement</td>
</tr>
</tbody>
</table>
Less than 50% of the settlements along Alternative $S_0$ route exhibit a diverse economy while for the majority of the settlements agriculture is the main economic activity.

6.5 COMPARISON BETWEEN ALTERNATIVES

6.5.1 Environment

This section presents the results of the selected environmental indicators of the two alternatives in one table (Table 6.2) to allow similarities and differences between the alternatives to be identified.

Table 6-2 Comparison Matrix using Selected Environment Indicators

<table>
<thead>
<tr>
<th>Impact Indicator</th>
<th>Units</th>
<th>Base Case</th>
<th>Alternative $S_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length of the Alternative</td>
<td>km</td>
<td>181</td>
<td>202</td>
</tr>
<tr>
<td>Length within Important Bird Areas (IBA)</td>
<td>km</td>
<td>1.5</td>
<td>2.</td>
</tr>
<tr>
<td>Total length within Natura 2000 Network</td>
<td>km</td>
<td>1.5</td>
<td>2.</td>
</tr>
<tr>
<td>Total forest clearance within the PPS</td>
<td>ha</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Area of montane and subalpine grasslands, meadows</td>
<td>ha</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>and pastures to be cleared</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area of agricultural lands and plantations to be cleared</td>
<td>ha</td>
<td>570</td>
<td>605</td>
</tr>
<tr>
<td>Total area of ‘wetland’ type habitats (standing water, lagoons, running waters incl. river crossings, saltmarshes) *</td>
<td>ha</td>
<td>3.0</td>
<td>2.</td>
</tr>
<tr>
<td>Total number of river crossings in rivers of perennial flow **</td>
<td>No.of rivers</td>
<td>30</td>
<td>21</td>
</tr>
</tbody>
</table>

* The calculation on the wetlands has to be taken with a precautionary approach as there is a relatively high degree of uncertainty due to the scale of the cartography (GIS layers) and the variable and constantly changing nature of the particular landscape feature. Nevertheless it is presented here as a rough estimate to assess potential differences between corridors.

**Data on the hydrological status (perennial or seasonal) of the rivers are according to the Hellenic Military Geographical Service (HMGS). Water bodies east of Veroia (east of river Potamos), and west of river Axios are not taken into account because the vast majority comprises channelized streams and/or irrigation works.

As demonstrated in the comparison matrix, the Base Case route comprises a shorter route (by about 20 km) compared to Alternative $S_0$. It also involves less traversing of protected areas (with regard to both IBA and Natura 2000 sites).
Due to its shorter length, Base Case route crosses significantly less areas of agricultural cultivations and plantations as well as montane and subalpine grasslands areas – the latter being important as such sites are candidate habitats for many rare flora taxa. On the other hand, Base Case route crosses a larger number of rivers and streams compared to Alternative S₃; however, it is considered that the associated impacts can be minimised with the adoption of appropriate preventive and mitigation measures.

As a result, the Base Case route is considered advantageous over the alternative S₃ route from an ecological point of view.

### 6.5.2 Cultural Heritage

For the purpose of route comparison, Cultural Heritage Indicators were developed as a measure of overall cultural heritage constraint associated with each route. Input for the indicators came from desktop research along with selective field confirmation. The assumption of the indicator system is based on the assumption that archaeological sites within the corridor represent the highest type of constraint and ICH the lowest; monuments represent a middle level of constraint. Based on this assumption the numbers of know sites of each type are weighted differently, archaeological sites highest and ICH lowest. A comparison the indicator values are presented in Table 6-3.

#### Table 6-3 Comparison Matrix -Cultural Heritage Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Base Case</th>
<th>Alternative S₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Indicator value from Archaeological Issues</td>
<td>120</td>
<td>252</td>
</tr>
<tr>
<td>2. Indicator value from Monuments</td>
<td>42</td>
<td>27</td>
</tr>
<tr>
<td>3. Value from Intangible Cultural Heritage (ICH)</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td>Total Indicator Value for Route</td>
<td>173</td>
<td>307</td>
</tr>
</tbody>
</table>

The matrix shows the weighted score or indicator associated with each type of site on each route. The Total Indicator Value for each route represents an estimated level of cultural heritage constraint for each route. According to this value the S₀ Alternative has a substantially higher level of constraint than the

---

1 ICH are sites that lack any outstanding cultural or scientific value, but are important in local community values and social traditions.
Base Case route, nearly twice the level of constraint\(^1\). The constraint value is not a reflection of “cultural importance” but stems from the level of anticipated difficulty, in terms of time and resources, associated with required mitigation measures.

On this basis, Base Case route is considered advantageous over Alternative \(S_0\) from the cultural heritage point of view. The Base Case route is also favoured by the Large Projects Department of the Ministry of Culture.

### 6.5.3 Socioeconomics

This section presents the results of the impacts indicators across both alternatives in one matrix (*Table 6.4*) allowing the identification of similarities and differences among both alternatives.

#### Table 6-4 Comparison Matrix using Selected Socioeconomics Indicators

<table>
<thead>
<tr>
<th>List of Impact Indicators</th>
<th>Base Case</th>
<th>Alternative (S_0)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics and Settlements Indicators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional government stakeholder</td>
<td>2 regions</td>
<td>2 regions</td>
</tr>
<tr>
<td>Local government stakeholders (municipalities)</td>
<td>10 municipalities (11 for 2 km corridor)</td>
<td>10 municipalities</td>
</tr>
<tr>
<td>Settlements located within the corridor routes (based on the X,Y coordinate layer)</td>
<td>22 settlements</td>
<td>33 settlements</td>
</tr>
<tr>
<td>Population in settlements within the 2 km corridor (based on the X,Y coordinate layer)</td>
<td>Approx 12,000 inhabitants</td>
<td>Approx. 7,000 inhabitants</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local Economy. Land Use and Livelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of agricultural lands</td>
</tr>
<tr>
<td>2km</td>
</tr>
<tr>
<td>Area of agricultural lands</td>
</tr>
<tr>
<td>Area of permanently irrigated agricultural land</td>
</tr>
<tr>
<td>Area of grazing lands</td>
</tr>
<tr>
<td>Area of permanent crops (fruit trees, vineyards and olive groves) (CORINE)</td>
</tr>
</tbody>
</table>

\(^1\) Nevertheless, it should be noted that the higher number of cultural heritage findings along Alternative S0 may be in part due to the fact that more research in the past has been conducted in the vicinity of the proposed route.
Sections of Base Case in which issues related to socio-economic factors have been highlighted include:

- Section from the tie-in point in Chalkidona Municipality to the settlement of Agios Loukas in Pella Municipality: this section crosses large areas of irrigated farmland, some with shallow underground pipes. Irrigated land typically produces higher value crops. The population along the route are heavily dependent on agricultural production as a key livelihood activity.

- Section from the settlement of Agios Loukas in Pella Municipality through the settlement of Polla Nera in Skydra Municipality: this section of the corridor crosses agricultural land with a high incidence of permanent crops most notably fruit trees. These crops cannot be easily replaced should they be removed.

- Area along the road between Perdikkas – Ptolemaida in Eordia Municipality: There are plans for further urbanisation along the road between two major population centres, crossing directly the pipeline route.

Sections of Alternative S₀ in which issues related to socio-economic factors have been highlighted include:

- Section from the tie-in point in Chalkidona Municipality to the settlement of Palai Lykogianni in Veroia Municipality: This section crosses large areas of irrigated farmland, some with shallow underground pipes. Irrigated land typically produces higher value crops. The population along the route are heavily dependent on agricultural production as a key livelihood activity.
• Re-routing around Veroia, passing near the settlements of Agios Nikolaos, Patris and Koutoschorion: The area to the north/north-west of the city of Veroia has undergone rapid expansion. The re-routing of the pipeline avoids the most densely settled areas but the overall area is heavily populated and continues to grow, with implications for road traffic and future conflict over land use.

• Planned windfarm development close to the settlement of Xirolivadon, Veroia Municipality: Close to the proposed corridor near the settlement of Xirolivadon a windfarm development has been proposed with the potential for conflict over land use in the area and issues around social conflict and cumulative impacts.

6.6 OVERALL CONCLUSION

Base Case route potentially faces fewer challenges in terms of cultural heritage impacts as there are fewer known cultural heritage sites along the route. It also exhibits clear advantages from an ecological point of view, as demonstrated in Section 6.5.1. Base Case will cross the Axios Natura 2000 site which is unavoidable. The impacts due to the crossing may be minimised by adopting trenchless crossing techniques (micro tunnelling or horizontal directional drilling underneath the protected area).

Alternative S₀ faces higher challenges with regards to cultural heritage due to a higher density of currently known archaeological sites within the corridor. Alternative S₀ will also cross the Axios Natura 2000 site, which is unavoidable, and will further cross a second Natura 2000 site (North Vourinos Mountain & Mellia - SPA GR1330002).

Based on the outcome of the overall alternatives appraisal and refinements made, TAP AG decided to select Base Case route as the ‘preferred route’ to take forward for further planning and for the approval process in Greece.

6.7 COMPRESSOR STATION

Two alternatives for the siting of the Compressor Station 2 (CS02) in Greece have been investigated and appraised. CS02 Alternative D is located approximately 1.5 km east of the Albanian border in the hill lands, approx 3 km to the southwest of Ieropigi village. The location takes into account the extension of the Larco nickel mine. CS02 Alternative C, is located
approximately 2 km to the West of Mesopotamia town in agricultural plains (pipeline route distance approx. 10 km from the border).

The preferred site is Alternative C, since the terrain is flat, as opposed to the hill lands near the border. Alternative D location has further constraints: It is surrounded by black pine forest, which would be partially needed to be cut, and the remote forested border hillands are bear habitats.

6.8 **No-Project Scenario**

More than two thirds of the world’s proven gas reserves lay in Russia, as well as in the Middle East and the Caspian Sea regions – proven gas reserves in these regions, as per 2008 data, are shown in *Figure 6-3*. These reserves are sufficient to meet European demand for many decades to come. Europe currently relies mostly on Russian gas supplies through several existing pipelines, and it has not yet linked its pipeline systems to the Caspian and Middle East gas reserves. However, Europe realizes the strategic need to diversify its gas supply.

**Figure 6-3**  Proven Gas Reserves (2008)
In this context, the realization of TAP project presents a number of benefits:

At international level, TAP provides the shortest route in the Southern Gas Corridor to give access to the new Caspian resources. TAP also provides for future options to accommodate interconnectors in the Balkan region and offers the possibility for an underground storage option (in Albania). The significant reverse flow capability of TAP will allow gas to flow not only from East to West but in the opposite direction. This will help to ensure that countries in the Balkan region will be in a position to secure the energy they require.

Implementation of the TAP Project will also bring about significant benefits to Greece. At the national level, the TAP Project will strengthen the role of Greece in the European energy sector. In addition, the country will benefit from the transit fees paid by the company to the Greek State. If some of these fees are channelled to the Regions of West and Central Macedonia, these benefits will also be dispersed to the areas affected by the Project. Furthermore, the fact that tie-in points are foreseen in the vicinity of large cities along the pipeline route makes it also technically feasible to provide gas to these regions at a later stage, provided that the commercial arrangements are undertaken by the Greek state.

At local level, especially during construction, the Project implementation will also create some limited, short term employment opportunities and economic benefits (through the procurement of materials and services), to the local economy, and will add small in numbers but permanent jobs and procurement of services opportunities for maintenance of the facilities.

On the basis of the benefits presented above and taking into account the possibilities to address potential adverse impacts associated with pipeline construction and operation, and to enhance positive ones, as these are set out in the following section, it is evident that Project implementation is providing a number of benefits that would not be there in a No-Project scenario.
7 \hspace{1cm} \textbf{ASSESSMENT AND MITIGATION OF IMPACTS}

7.1 \hspace{1cm} \textbf{ASSESSMENT METHODOLOGY}

7.1.1 \hspace{1cm} \textbf{Introduction}

In the PEIA, which constitutes a preliminary assessment step\(^1\), potential impacts on environmental and social receptors and resources are identified based on the understanding of the baseline data collected to date (refer to Section 4) and the current understanding of the Project (refer to Section 5). Receptors in this case are defined as people (including local residents, those who work in the area and visitors to the area), physical, natural resources (e.g. soils and land, protected habitats and species) and cultural heritage (e.g. historic sites).

The significance of the potential impact is discussed with the aim of determining if the impact needs to be considered in further detail within the subsequent full ESIA and to consider the nature and approach of appropriate mitigation measures. Where impacts are identified which are likely to be significant, the initial approach for avoiding, reducing or compensating for these is discussed.

7.1.2 \hspace{1cm} \textbf{Impact Assessment Methodology}

Impacts are assessed by comparing the baseline conditions (i.e. the situation without the Project) with the conditions that will prevail if the Project is constructed and operated. Impacts are discussed in relation to the potential nature of the impact based on the criteria presented in Box 7-1.

\[^1\text{In case the PEIA will end up with a positive Preliminary Environmental Assessment and Evaluation (so-called Environmental Pre-licence) that is issued by the competent authority, a full Environmental and Social Impact Assessment will subsequently be prepared for the Project.} \]
Box 7-1 Types of Environmental and Social Impact

**Positive impacts:** effects that have a beneficial influence on receptors and resources.

**Adverse impacts:** effects that have an adverse influence on receptors or resources.

**Permanent impacts:** effects that result from an irreversible change to the baseline environment (e.g. loss of features caused by land take).

**Temporary or short term impacts:** effects that persist for a limited period only, due for example to particular construction activities (e.g. noise from construction plant). The duration of these effects is identified.

**Long term impacts:** effects that will continue over a long period, for example during operation, but that will cease on closure of the plant (e.g. emissions from the compressor station).

**Primary impacts:** effects that result immediately from Project actions such as emissions, land take, etc.

**Secondary and higher order impacts (indirect or induced):** effects that occur as a result of primary effects, for example, impacts on ecosystems can be caused by changes in air quality resulting from Project emissions.

**Direct impacts:** effects that arise from activities that form an integral part of the Project.

**Indirect impacts:** effects that arise from activities that are not part of the Project but which are stimulated by it (e.g. sewage pollution caused by people moving into the area to work on the Project).

**Abnormal events:** impacts associated with abnormal events within and outside the Project (such as explosions or flooding).

**Combined impacts:** effects that arise from the combination of different effects on specific resource or receptor e.g. noise, dust and traffic congestion all affecting the same group of residents.

**Cumulative impacts:** where the Project is taking place at the same time as other developments and they have cumulative effects on the same receptors and resources.

The Sections that follow present a list of the main potential environmental, socioeconomic and cultural heritage impacts for the construction, pre-commissioning, operation and decommissioning of the pipeline Project in Greece. The impacts discussed are characterised by the following information:
• **Impact categories** intended as the environmental, socioeconomic and cultural heritage component potentially affected by the Project’s activities throughout the different Project phases. Impact categories include:
  
  • Biodiversity and Nature Conservation;
  • Landscape;
  • Water Environment – Surface Waters;
  • Geology, Soils and Contaminated Land;
  • Air Quality and Climate;
  • Noise and Vibration;
  • Use of Resources and Generation of Waste;
  • Cultural Heritage;
  • Land Use;
  • Economy and Employment;
  • Infrastructure;
  • Presence of Workforce;
  • Community Health and Safety; and
  • Labour and Working Conditions;

• **Potential Impacts of Significance**: types of impact or sources of impacts that could occur from the Project on the basis of information currently available (project design and baseline). The magnitude and significance of the impacts will be ascertained during the detailed ESIA;

• **Area of Influence**: the geographical area which could be potentially affected by the impact. The definition of the area of influence is to be intended as indicative. The extent of the area of influence will be ascertained during the detailed ESIA;

• **Mitigation Options**: types of mitigation and control measures that may be considered where significant impacts are identified during the assessment.
With regards to the Area of Influence the following criteria have been adopted:

- **Local** – impacts that affect local environmental, socioeconomic or cultural heritage resources or are restricted to a single habitat/biotope, a single (local) administrative area or a single community. Although considered local, the geographical extent of each impact within this category can be variable, depending on the impact type and location. Local impacts may be restricted to the Safety zone (PPS, 8 m wide), the Working Strip (approximately 38 m wide) and areas directly affected by associated facilities (e.g. access roads, workers camps and pipe yards), however there will be local impacts that extend beyond but are still within the local context (e.g. within hundreds of meters or a few kilometres from the PPS).

- **Regional/Provincial** – impacts that affect regional environmental, socioeconomic or cultural heritage resources or are felt at a regional scale as determined by habitat type, administrative boundaries or community. Tentatively the geographical extent of regional impacts will be up to tens of kilometres.

- **National** – impacts that affect national environmental, socioeconomic or cultural heritage resources or affect an area that is nationally protected/important. Tentatively the geographical extent of national impacts will be up to hundreds of kilometres.

- **Trans-boundary/International** – impacts that are experienced in one country (or several countries) as a result of activities in another.
7.2 SUMMARY OF ISSUES TO BE INCLUDED IN THE SCOPE OF THE ESIA

The key environmental and social issues that have been identified during the scoping exercise (and that comprise the technical scope of the ESIA) are summarised in Table 7.1 below.

Table 7-1 Potential Environmental and Social Issues Included in the Scope of the ESIA

<table>
<thead>
<tr>
<th></th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Significant Effect Unlikely</td>
<td>Significant Effect Possible</td>
</tr>
<tr>
<td>Biodiversity and Nature Conservation</td>
<td>✓ (-)</td>
<td>✓ (-)</td>
</tr>
<tr>
<td>Landscape</td>
<td>✓ (-)</td>
<td>✓ (-)</td>
</tr>
<tr>
<td>Water Environment-Surface Waters</td>
<td>✓ (-)</td>
<td>✓ (-)</td>
</tr>
<tr>
<td>Geology, Soils and Contaminated Land</td>
<td>✓ (-)</td>
<td>✓ (-)</td>
</tr>
<tr>
<td>Air Quality and Climate</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Noise and Vibration</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Use of Resources and Generation of Waste</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Cultural Heritage (known and potential) including “intangible cultural heritage”</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Land Use</td>
<td>✓ (-/+ )</td>
<td></td>
</tr>
<tr>
<td>Economy and Employment</td>
<td>✓ (-/+ )</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>✓ (-/+ )</td>
<td></td>
</tr>
<tr>
<td>Presence of Workforce</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Community Health and Safety</td>
<td>✓ (-)</td>
<td></td>
</tr>
<tr>
<td>Labour and Working Conditions</td>
<td>✓ (-/+ )</td>
<td></td>
</tr>
</tbody>
</table>

✓ Topic will be included in ESIA
+ positive effect.
- negative effect.
+/- both positive and negative effects possible.

The topics presented in the above table are discussed in further detail below.
7.3 POTENTIAL IMPACTS AND MITIGATION DURING CONSTRUCTION

7.3.1 Biodiversity and Nature Conservation

There are three major categories of impacts on flora and fauna during the pipeline construction:

- Impacts from habitat loss due to the removal of the vegetation along the Working Strip. Such impacts will be both temporary and long-term: Temporary impacts will arise from the Working Strip, camps and pipe yards which will be reinstated to pre-construction conditions once construction is complete, with the only exception being forested areas where an 8 m wide strip will remain clear for pipeline protection reasons and inspection purposes. Permanent/long term impacts will arise from the permanent above ground features of the pipeline (i.e. compressor station and block valve stations) and the 8 m corridor in forested areas where no deep rooting vegetation will be allowed in order not to compromise the integrity of the pipeline.

- Disturbance on localised populations of limited dispersal ability (i.e. in cases where localised stands of vegetation or fauna habitats of particular conservation interest cannot be avoided by the construction)

- Indirect disturbance to fauna and flora species of nature conservation interest from the Project’s activities (e.g. noise, aqueous discharges, sediments plumes, abstraction of water for hydro testing, disturbance by the presence of construction workforce, potentially greater human pressure to previously inaccessible areas) with particular reference to sensitive areas such as nesting places, old growth forests, wetlands, rivers, riparian vegetation and areas identified as rich in endemic and protected species.

Habitat loss during the construction stage of the Project may result from the clearance of the Working Strip, the trenching for the installation of the pipeline and the associated works, i.e. construction of access roads, block valve stations, etc. The standard Working Strip will have a width of 38 m, which can be reduced where special environmental restrictions apply, provided that local conditions technically permit.
The clearance of the construction strip along the preferred Base Case route will lead to the deforestation of approximately 60 ha of forest, of which 2.5 ha of coniferous forest mainly *Pinus spp* and 37 ha of oak forest and 23 ha of *Fagus sylvatica* forest.

Any impacts to riparian vegetation, although important given the sensitivity of this type of vegetation, will have a local character and generally be limited to the construction strip at the location of the crossing. Major rivers, i.e. Axios, Aliakmonas, can be crossed by trenchless techniques as Horizontal Directional Drilling (HDD) or microtunnelling, provided that geotechnical conditions allow it (subject to further geotechnical investigations). Trenchless crossings avoid impacts to the river itself (i.e. banks, riverbed, water quality) and loss of the riparian vegetation. This is of particular importance at the Axios River where the pipeline is crossing a Natura 2000 site, but also the Aliakmonas is lined by vegetation of conservation interest.

The proposed site for CS02 near the border to Albania is located on agricultural land. The areas being considered are predominantly flat and levelling work is expected to be limited. As a result, impacts to natural vegetation due to the clearance of the area and the construction activities are expected in general not to be significant.

The extent to which the clear-cut of the pipeline corridor will induce significant habitat changes to certain forest species will be examined during the detailed ESIA study.

In dense and intact woodland, the deforested zone is expected to look as a forest opening, similar to the ones created naturally by thunderstorms and snowfall in forests or by other linear infrastructures such as overhead transmission lines. Due to technical reasons, forest tree species will however not be allowed to recolonise the safety strip and access tracks.

However, there will be complete reinstatement of the land, except access zone, and there will be re-seeding/re-planting of the disturbed areas with local species.

In order to avoid losses of species of conservation concern, translocation of individual rare plants will be considered as a mitigation measure (e.g. relocation of orchid stands before clearing the construction strip) and as an
international best practice measure. Sections where this is required will be indentified in the detailed ESIA.

Due to disturbance during the pipeline construction localised species of limited dispersal abilities such as freshwater taxa may suffer locally: for example freshwater fish which appear in small populations and are sensitive to water flow limitations may be significantly impacted in the case of small wetlands if the flow of water is interrupted. This subject will be examined in detail during the ESIA study and emphasis will be given to Balkan endemic freshwater fish and other protected species. The expected area of influence due to construction activities in sensitive areas such as nesting places or rivers will be fully assessed during the ESIA stage and appropriate mitigation measures will be developed.

Several species such as large mammals and birds are often stressed by human disturbance which will particularly occur during construction; disturbance occasionally is shown by reduced breeding success due to abandonment of nests or fledglings. The disturbance parameter is likely to have an adverse impact for populations along the least accessible areas crossed. This subject will be examined in detail during the ESIA study.

Any agricultural cultivation along the construction strip will be removed during construction preparation. However, after reinstatement the land will be returned to the owners to resume their previous activities post construction. The only remaining permanent restriction is that, within the pipeline protection strip of 8 m (4 m from each side of the pipeline), the cultivation of trees or generally plants with deep rooting system will not be allowed.

In addition, flora will be generally affected by dust emissions during earthworks and movement of construction vehicles. Dust may settle on plant leaves, thus inhibiting photosynthesis and reducing productivity, or may settle on flowers during the blooming period and affect plant reproduction. The relevance will inter alia depend on factors like wind drift and precipitation. However, given that the construction periods at individual locations are generally short (a matter of weeks to a maximum of a few months) at any single site, no significant impacts are anticipated.

Apart from dust, other airborne pollutants expected are SO₂, NOₓ and hydrocarbons, which are emitted by internal combustion engines of vehicles, machinery and other installations at the construction sites. This however does
A Biodiversity Action Plan (BAP) will be designed for the life-time of the Project including Action Plans for specific important species (e.g. brown bear) and habitats/environments to be developed where required.

not constitute a significant factor as it will be short term only and negligible compared to e.g. pollution from traffic on regular roads. It is envisaged that the following preventative/mitigation measures will be applied to protect biodiversity and nature conservation resource:

- Where possible the pipeline route and siting of associated infrastructure will avoid sensitive features;
- Alternative construction techniques to open cut trenching and backfilling (e.g. Horizontal Directional Drilling) will be considered;
- The Project footprint will be minimised where design allows to avoid sensitive features, in particular tree vegetation including old single trees (e.g. narrower Working Strip);
- Pre-construction conditions will be restored as far as possible (e.g. re-vegetation of Working Strip) - Vegetation/Landscape Restoration Plan with typical local species;
- Dust, air emissions, aqueous discharges and waste will be appropriately managed to minimise impacts on flora, fauna and ecosystems (e.g. locating fixed machinery as far as possible from sensitive receptors);
- Construction activities will be restricted during certain periods/seasons (e.g. breeding birds season) in sensitive areas;
- Endemic/rare plant species will be relocated / transplanted to suitable nearby habitats;
- Impacts on flora and fauna at sensitive locations will be monitored - Environmental Monitoring Plan (e.g. daily survey of trench before commencement of work and rescue of animals that may have fallen into the trench);
- The Environmental and Social Management and Monitoring Plan (ESMMP) will be developed with specific measures to protect flora and fauna; and
- A Biodiversity Action Plan (BAP) will be designed for the life-time of the Project including Action Plans for specific important species (e.g. brown bear) and habitats/environments to be developed where required.
7.3.2 Landscape

The construction of the proposed pipeline will result in physical changes to the landscape. Potential impacts include:

- Temporary disturbance of undeveloped farmland required for site clearance at the compressor station and along the pipeline working strip;
- Temporary presence of topsoil and subsoil stockpiles;
- Temporary presence of construction plant, machinery and vehicles;
- Permanent loss of mature vegetation (trees) in the safety strip; and
- Installation of permanent above ground stations: 1 compressor station, and approximately 8 block valve stations.

Temporary impacts on the character of the surrounding area will arise as a result of the visibility of the construction works. Limited permanent changes to the landscape will occur from the implementation of the compressor station and unavoidable forest cuttings. The compressor station will be the most significant element introduced to the landscape due to its size and character of an industrial installation, whereas the block valve stations are comparatively negligible structures that in dimensions compare to agricultural buildings.

During the construction of the pipeline efforts will be made to minimize footprint where required for protection of sensitive features and avoidance of forest losses (e.g. narrower Working Strip). Where reasonably practical the land will be fully reinstated to pre-construction conditions. Specific details will be included in the Vegetation/Landscape Restoration Plan which will be developed and defined during the ESIA. Additionally, visual mitigation measures will be put in place where deemed necessary (e.g. vegetation screens to shield views towards the compressor station(s)). Any settings of new roads, temporary accesses and camps will be located away from sensitive landscape locations if possible.

Due to the proposed locations, it is not anticipated that the permanent above-ground structures will have any significant adverse impact on landscape elements which are of particular value for recreation or tourism.

In the ESIA this will be further developed based on viewshed analysis (zone of visual influence), and photomontages from potentially relevant viewpoints
towards the Compressor Station such as from the nearest settlements or prominent viewpoints that may be used e.g. by hikers.

7.3.3 Water Environment-Surface Water

The following potential impacts to the water environment were identified during the scoping phase of the Project.

- Impacts to aquatic habitats, water quality & river morphology from river crossings of the pipeline and access roads;
- Sediment runoff with stormwater from Working Strip, yards, camps and access roads and due to this potential turbidity introduced into surface waters;
- Accidental pollution by oil and lubricants or fuels from machinery on Working Strip, yards, camps and access roads; and
- Accidental pollution by waste water and solid wastes (from camps, Working Strip) not properly captured or managed.

Impacts of crossings on aquatic habitats, water quality & river morphology

The area of influence of impacts to river morphology and water quality is highly dependant on the specific characteristics and local conditions of the watercourse crossed, but might extend both upstream and in particular downstream of the crossing.

The proposed pipeline route crosses a number of rivers, streams or irrigation channels, as described earlier in this document. At least for smaller rivers and creeks with few or intermittent run off the standard method for crossing is the open-cut method, as outlined in Section 5.

The open-cut method, when combined with the appropriate scheduling of the works (during low water volume periods) and diversion of water flow during the works, can minimize the environmental impacts related to water turbidity and chemical characteristics or changes to river bed morphology. In special circumstances, i.e. in watercourses of high ecological value, very steep river banks or near Installed infrastructure, HDD or thrust boring (Jack and Bore method) will be considered. Trenchless techniques generally minimize environmental impacts to the water body or the riparian vegetation but the feasibility of application depends on the pertaining geo-technical conditions.
Provided that the subsurface conditions allow, the HDD method is considered for Axios River (Natura 2000 site), and potentially also for Aliakmonas. The pros and cons of the crossing technology options at these locations will be discussed in detail in the ESIA and appropriate mitigation will be developed to protect the riparian environment.

Apart from efforts to minimise numbers of river crossings and carefully select crossing locations as to minimise any impact to riparian vegetation, river channel and habitat, a working window time frame will be selected for sensitive river crossings to protect aquatic species. The locations, if any, that require such an approach will be identified during the ESIA stage. In addition, channel, banks and riparian vegetation will be fully reinstated to pre-construction status where possible, and an appropriate Environmental Monitoring Plan will be implemented.

*Impacts of sediment run-off*

During periods of heavy rainfall surface water run-off from areas of extensive earthworks or stored material has the potential to transport soil material into local watercourses and in consequence increase the turbidity of these watercourses. Similar impacts will also occur if the dewatering of any trenches in areas with a high ground water table is not properly managed.

Appropriate management of construction zone, and all associated facilities e.g access roads, yards, camps etc will minimize any sediment runoff into water courses. Silt fences, silt traps, vegetation of stockpiles and of marginal areas will be some of the measures to be applied in management of construction zone and associated facilities. Detailed measures and monitoring of water courses and water bodies will be defined in the Environmental Monitoring Plan which will be developed during the ESIA stage.

*Impacts of Hydrotesting*

Hydrotesting of the pipeline prior to operation may also represent an issue to surface water quality and quantity. It employs water abstraction from local water sources and filling up the pipe-line, section after section, to pressure test and ensure integrity of construction. Depending on water quality, biocides may need to be injected to the water to avoid the building up of microorganisms in the pipeline. After its use, the water will have to be discharged to local receptors. There is a well established international practice to avoid significant impacts from hydrotesting, and a plan to reduce the overall water demand for
this activity will be developed. The provision of re-use water from one testing section to the next where feasible, will be applied. Also considering the water framework directive, it will be attempted to abstract and discharge hydrotest water in the same catchment basin as to not disturb the quantity within a basin. The intake and discharge points will be selected in order to avoid quality or quantity impacts, seasonal natural flow variations will be considered as necessary to achieve this and there will be water treatment if necessary, prior to discharge.

**Accidental Pollution by Oil or Lubricants/ Chemical from Construction Machinery**

In order to prevent any oil or chemical contamination from machinery on Working Strip, yards, camps and access roads, the following good site management measures will be implemented:

- Fuelling/bunkering procedure for machinery, generators, etc;
- Bunded or contained oil/fuel storages;
- Oil & Chemicals Spill Contingency Prevention & Planning;
- Chemical handling procedures;
- Oil & Chemical spill response kit on sites;
- HSE Training of all on-site personnel on environmental awareness (including managing erosion and siltation on site and waste management) and oil & chemical spill prevention and response [Note - this mitigation measure is valid for all impacts]; and
- Enforcement of measures by designated Environmental Construction Supervisors.

**Accidental pollution by waste water and solid wastes**

Generation of waste water and solid waste (from camps, Working Strip) will be minimised through the employment of waste minimisation techniques at source. The treatment of waste water prior to discharge in any water body, and the location of yards and camps away from water courses/water bodies will ensure that the impact to local receptors will be kept to a minimum. In the ESIA stage, a Waste Management Plan will be outlined which will be the framework for determining site specific detailed plans at the construction stage.
Measures implemented as standard good practice for minimizing any impact on surface water quality as described above usually include:

- Provision that topsoil and other debris is protected against heavy rainfall and eventual entrainment to nearby surface waters;

- In case water needs to be removed from the trench (after rainfall or due to high water table), provision will be made that water is filtrated through the ground prior to reaching surface or underground waters, or alternatively directly discharged to surface waters with prior trapping of sediments and any pollutants;

- Reuse water for hydrotesting in subsequent sections of the pipeline;

- Where raw water quality allows, avoid the use of biocides in hydrotesting water altogether;

- Discharge water from hydrotesting to local receptors, taking care not to alter their hydrological patterns;

- Careful management of liquid and solid waste in order to ensure that they will not find their way to surface or underground waters; and

- Appropriate emergency response measures to address accidental spills or other incidents at construction sites.

7.3.4 Geology, Soils and Contaminated Land

Project impacts to the topsoil, subsoil and geological resource during pipeline construction will mainly be related to trenching and the movement of heavy machinery which will result in:

- Physical damage through soil compaction and accidental contamination;

- Loss of topsoil through the clearance of the Working Strip, logistic sites (yards, camp sites) and access roads; and resulting from the construction of the compressor station and block valve stations

- Loss of soil and geological resource due to excavation works during construction including off-site quarrying where needed (compressor station and block valve stations).
In rocky sections with shallow soil, heavy duty trenching works including blasting may be required. According to present planning detail, no significant rock or earth movements (such as crest cuttings) or deposition of significant amounts of overburden will be necessary, which would require dedicated disposal sites for surplus material. It is anticipated that most of the excavated materials can be backfilled or integrated in site reinstatement works. The ESIA will further investigate this based on more detailed planning information as becomes available.

Potential pollution may also arise from cross-contamination due to excavating and handling of soils and subsurface contaminated from past activities in the area of the Working Strip.

During the route refinement of the Project, a careful route selection was carried out in order to avoid potential contaminated areas, dump sites, illegal landfills. More detailed enquiries with the municipality administrations will be undertaken as part of the ESIA consultation to verify if any known or suspected areas are within the routing corridor. In case additional information becomes available that indicate a potential risk of mobilisation of past contamination by the pipeline construction activities either a local reroute or special provisions for construction and disposal of contaminated materials will be developed specific to the relevant section.

During the preparation of the Working Strip, the topsoil will be removed first and stored (along the side of the construction zone) to avoid mixing with deeper soil layers or base strata. The topsoil will then be reapplied during the reinstatement activities. Detail of such measures will be provided in the Vegetation/ Landscape Restoration Plan to be set out in the framework of the ESIA.

The main Project impact to soil will be compaction, i.e. reduction of soil porosity, which affects its permeability by water and other substances. Soil compaction may be expected when the weight of heavy machinery exceeds the natural strength of soil (depending on the soil type).

Loose, unconsolidated soil deposits may require bog mats for vehicle access. Soil handling will have to be conducted with great care because of the potentially wet nature of the materials to reduce the risk of compaction and soil damage. Trench sides over the wet ground may also have to be shored to provide stability in the weak material.
Detailed information on soil types along the proposed pipeline route will be collected during the ESIA stage including taking typical soil core profiles in the field. However, in general, where the high potential for compaction is likely actions will be taken to suitably store the soil and/or reinstatement it to ensure soil recovery (methods considered may include storing soil in mounds no greater than 2 m in height, covering from rainfall and reinstating in dry conditions to avoid compaction, deep ploughing or similar methods to loosen compacted soil).

In areas susceptible to soil erosion, i.e. steep slopes or river banks, special engineering solutions will be applied which will comprise ditch breakers with cement-sandbags, diversion berms or gabions. Where these are not appropriate site specific slope stability studies will be undertaken.

A detailed Construction Site Management Plan and an Oil and Chemicals Spill Contingency Prevention Plan will be developed and implemented during the construction phase in order to prevent or mitigate any potential impact in soil, topsoil and geological resource.

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### Air Quality and Climate

During Project construction, the impacts to atmospheric quality are related to the following:

- Temporary dust emissions from earth movements, excavation, vehicles movement, stockpiles, unpaved surfaces, etc. along the Working Strip, access roads, yards and camps. Receptors will mainly comprise residential population of nearby settlements and workers, fauna and flora species, cultural, historic, water quality, etc.

- Temporary emissions of flue gases to the atmosphere from machinery and vehicles (i.e. generators, excavators, bulldozers, side booms, trucks, cars, compressors for hydrotest etc.). Receptors will include residential population, workers, fauna and flora species, water quality, etc.

### Dust Emissions

Mitigation measures to control dust emissions will include good construction site management practices (i.e. such as covering of loose materials, vehicle
speed limits, watering/spraying dusty surfaces in dry weather, sheeting of trucks).

Emissions of Pollutants

The atmospheric pollutants related to fuel combustion from construction machinery \((\text{NO}_x, \text{CO}, \text{SO}_2, \text{etc.})\) will be limited and localised, and of a temporary nature. The construction traffic and machinery emission can be compared with traffic on a country side road e.g. during harvesting period and as such negligible with following mitigation measures in place:

- Regular maintenance of equipment and vehicles;
- Routing of construction traffic away from sensitive areas;
- Training of operators and drivers;
- Avoiding construction traffic to cross through densely populated areas or historic centres;
- Implementation of a Traffic Management Plan;
- Use of low sulphur fuels if available; and
- Monitoring of main emission sources (generators, compressors) through the development and implementation of an appropriate ESMMP.

### 7.3.6 Noise and Vibration

Noise during Project construction will mainly be related to the operation of vehicles and machinery and will typically be a level of noise as that encountered on construction sites. Particularly noisy activities are temporary in nature and infrequent along the pipeline route. These may include piling for foundations at the compressor station, works at HDD locations and at locations / sections which may require blasting activities due to hard strata encountered during trenching. The location and requirement of these activities will be confirmed and assessed during the full ESIA.
Besides complying with the prevailing legislative framework, in construction areas neighbouring settlements further proposed mitigation measures include:

- Good construction site management;
- Limiting working hours close to sensitive receptors;
- Using specific mitigation on noisy equipment (acoustic shielding);
- Locating noisy equipment (e.g. generators, compressors) away from noise sensitive receptors;
- Implementing speed limits for construction vehicles;
- Modelling of main noise emission sources (generators, compressors); and
- Monitoring of main emission sources (generators, compressors) through the implementation of an appropriate ESMMP.

In general, noisy construction activities will be limited to the daytime (night work may only be undertaken in exceptional circumstances).

Project construction will entail some temporary, localized, heavy ground works that will generate vibrations, especially in case of piling or blasting. Depending on the soil characteristics and on the distance to the nearest settlement, these activities could produce critical vibrations for houses in the vicinity, especially if of wood beam floors and ceilings or historic building structures. However, it is unlikely that vibrations will be a relevant impact factor since the route and the compressor station site(s) are at distance from settlements.

The full ESIA will identify potentially sensitive areas for which mitigation should be applied such as bore piles, blasting with micro-charges and other vibration and noise minimising methods. A standard measure is a pre-construction conditions assessment of the structures in the vicinity (existing cracks etc.) in order to be able to objectively assess if actual damage has resulted from construction.

### 7.3.7 Use of Resources and Generation of Waste and Refuse

The potential impact on resources and generation of waste during the construction phase are mainly related to use of large quantities of construction material, disposal of construction waste, transportation of construction material and waste, consumption of fuel by vehicles and machinery, sewage (black and
grey water) management and disposal, use of water for construction activities, camps, yards and use of water for pre-commissioning (hydrotesting).

The area of influence of these potential impacts will be at local or regional level depending on impact and specific location of waste disposal sites and origin of construction material and fuel.

In order to prevent/minimize any impacts from use of resources and waste generation/disposal, materials will be sourced utilising sustainable procurement principles and waste will be disposed of at an appropriate facility as close as possible to the section of the Project route where it is generated. Beneficial uses or opportunities for recycling construction spoil and other potential waste will be identified wherever possible.

As part of the full ESIA, details of anticipated waste and waste water types and quantities will be compiled. Based on this data an appropriate outline waste management plan and system will be defined, along with the ESMMP.

As described above, there will be evaluation/assessment of water sources for hydrotesting so as to avoid resource conflicts and minimise impacts to other water users and aquatic habitats.

7.3.8 Cultural Heritage

Potential impacts to cultural heritage are physical impacts related to the construction process. These are primarily direct physical impacts caused by ground disturbing activities such as right of way clearing and grading, and pipe trench excavation. The passing of heavy vehicles near to or on top of Cultural Heritage sites can also be destructive. When an archaeological site is impacted, buried artefacts and structures can be damaged and destroyed. Such physical damage will result in the loss of all of the knowledge and cultural values that could have been gained from subsequent study of the materials. Impacts to monuments, on the other hand, are rarely direct with damage from the nearby passing of heavy equipment or implementation of other vibration-causing construction processes being the most common sources of monument damage. ICH, including monuments and other more minor structures, could be impacted by TAP construction activities as well. In this case traditional owners and users of the sites and structures can be deprived of access to the sites temporarily, during the construction process. Also, where direct physical impacts occur, they will cause permanent damage.
and thereby deprive the relevant communities of the use of the sites permanently.

This generic description of impacts should be considered in relation to the site inventory of archaeological sites, monuments and ICH. Those sites that are listed in our present inventory are the resources at risk, each with its specific characteristics. The severity of any specific impact will be a combination of the importance of the resource itself and the extent of the physical damage to it. Risk of impact is, in general, is much higher for archaeological resources because they are buried and difficult to see. A known archaeological sites may often have unknown boundaries that can only be defined by subsurface investigation. Further, there is the risk of encountering completely new and previously unknown archaeological sites during construction, so called “chance finds”. Monuments, as with any other above-ground structures are relatively easy to avoid at the design stage, the primary risk being, as mentioned, damage from any vibration-causing construction activity. ICH sites and structures are sometimes harder to recognize than monuments and may be unintentionally damaged by construction activity. Avoidance of Cultural Heritage of any kind is the primary and preferred mitigation measure. So the focus of the investigations to date has been on identifying those sites that lie within the TAP project’s proposed physical footprint.

The PEIA study involved thorough desk top research with selective field visits to identify cultural or archaeological sites of interest.

The overall objective was to identify the known cultural heritage sites in the Study Area including archaeological sites, monuments and intangible cultural heritage (ICH) and to assess the cultural heritage potential of areas for which no surveys have been conducted.

The archaeologists also consulted with Ephorates of Antiquities responsible for the Study Area including the following:

- 30th Ephorate of Prehistoric and Classical Antiquities for the District of Kozani;
- 16th Ephorate of Byzantine Antiquities for the District of Kastoria and Florina; and,
- 17th Ephorate of Prehistoric and Classical Antiquities, responsible for the Districts of Florina and Imathia.
Data acquired from the Ephorates at the time of the present study covered the Study Area corridor along the proposed pipeline route and any Project installations. The data was examined at what level the presence or the possibility of archaeological findings in each place may interfere with the Project design. Furthermore, the significance of each place was assessed on the basis of the proximity to the proposed Project installations and the likely restrictions imposed by the Archaeological Authorities. As a result, it was ensured that on the basis of this existing information, the Project installations will not interfere with areas of archaeological or cultural significance and thus the Project impact to the cultural heritage environment is limited.

The on-going consultation with the competent Ephorates of Antiquities through the Large Project Office of Ministry of Culture is expected to provide an improved understanding of the cultural and archaeological environment in the Study Area and add new or unpublished information. The consideration of this information during the project design will be undertaken at the full ESIA stage to ensure that any significant impact to cultural heritage is avoided.

Foreseen mitigation measures will include the following:

- **Development of a Cultural Heritage Management Plan (including ICH);**

- **Detailed reconnaissance surveys of known monuments, ICH and archaeological sites;**

- **Implementation of archaeological monitoring and a “chance finds” procedure with special focus on high potential archaeological areas;**

- **Avoidance of certain and likely impacts by project redesign for archaeological site, monuments and ICH;**

- **Use of low special impact construction techniques where complete avoidance (e.g. re-routing) is not feasible; and**

- **Removal of resources by rescue excavations and associated studies.**

### 7.3.9 Land Use

During construction, temporary land use changes will result, associated with the Working Strip for the pipeline and associated facilities such as stock yards, construction worker camps and some access roads.
The Working Strip for the pipeline will in general be 38 m, with the option to reduce this to 28 m where socio-economic, environmental or technical restrictions apply. The Working Strip will contain all of the construction activities associated with the pipeline from land preparation till reinstatement.

In order to minimise the impact of change in land use on the natural environment and avoid settlements and structures, the pipeline route and associated facilities will be preferentially located in agricultural land. In particular, land used for annual crops is preferred for the pipeline route. Following construction, land will be reinstated and returned to its original owner and use, where possible.

In relation to the pipeline impacts to annual crops and associated livelihoods will be temporary in nature as these can be grown along the Working Strip following reinstatement. However, permanent crops, such as olive and fruit trees, cannot be grown in the 8 m permanent pipeline protection strip (4 m either side of the pipeline), with longer term implications on livelihoods. Furthermore the construction of structures will be restricted in a corridor of maximum 60 m and the establishment of cluster of houses and /or industrial infrastructure in a corridor of maximum 200 m. There will be no permanent change in land ownership associated with the pipeline but the restrictions outlined above on land use above the pipeline will be put in place for safety reasons.

Permanent land take will occur in relation to the compressor station and eight block valve stations, as well as some of the access roads. The size of the land plot required for the compressor station is estimated to be approximately 41 ha. Block valve stations usually cover a total surface area of approximately 20x30 m. Some additional land may also be required temporarily during construction at these sites.

In order to avoid or mitigate any impact on owners and users affected by both the temporary and permanent land take the following measures will be implemented where appropriate:

- All permanent or temporary acquisition of land will be carried out in accordance with Greek Legislation.
- The Project will develop and implement a Resettlement Action Plan and Livelihood Restorations Plan (LRP) setting out how resettlement for permanent and temporary acquisition of land will be managed,
compensated and mitigated in line with TAP AG’s Strategy for the ‘Acquisition of Land and Easement’ and EBRD’s PR5.

- The Project will ensure that where possible the land is restored to its previous use and returned to its previous users on completion of construction in line with the LRP.
- The Project will engage with municipalities and others stakeholders along the route in line with TAP AG’s Stakeholder Engagement Strategy and EBRD’s Performance Requirements.

The pipeline route passes through the PPC lignite concession and mining areas near Ptolemaida and land marked by some municipalities for industrial parks. This could cause conflict over future land use due to the conflicting needs of the Project and other land owners.

In order to mitigate and avoid conflict over potential land use in the area ongoing consultation will be undertaken with stakeholders identified along the route. Most notably consultation will continue with the PPC and municipalities to reach agreement over future land use in the area and restrictions associated with the presence of the pipeline.

7.3.10 Economy and Employment

Economic impacts during the construction phase can be expected to include both positive and negative impacts. Positive impacts may include the generation of direct and indirect employment for people living in the Study Area, induced economic impacts and wider economic impacts through improvements to infrastructure (e.g. improvement of roads in the Study Area). Potential negative impacts may include short term pressure on existing social and physical infrastructure, livelihoods impacts associated with land use, discussed above, and increased costs for particular goods.

Employment and Procurement

The workforce related to Project activities during construction stage is preliminary estimated to peak at some 1,500 staff overall. Although many of this staff will be specialized and provided by the contractor, it is anticipated that there will be also limited, short term opportunities for local employment.

As described in the socioeconomic baseline, there are high levels of under- and unemployment in a significant portion of the settlements situated along
the pipeline route. Hence, there is a recognized need for employment generation in the local area.

It is likely that the construction workers will be organised in several separate teams at work fronts of about 20 km long. Some of the tasks undertaken will not require highly skilled labour and the work could potentially be subcontracted to local companies by the main construction contractor. Other elements will require labour with specialist skills that will have to be sourced outside the immediate area. In terms of national impact, employment opportunities can be expected for pipeline construction specialists and related goods and services. In local communities along the pipeline route and in the surrounding municipalities, direct employment opportunities may be more limited and/or not meet local hopes or expectations.

TAP AG will work to maximise positive employment and procurement benefits to nearby settlements through the following measures in line with TAP AG’s Local Content Strategy and CSR Policy. In accordance with these policies, TAP AG will:

- Provide a fair and transparent recruitment process and enhance the local skills base through training provided by TAP AG.

- Purchase goods from local suppliers where possible in line with TAP AG’s Local Content Strategy and CSR Policy.

In addition to employment on the construction sites there may be other opportunities for direct employment during the construction phase. Examples include jobs in catering and food provision at the construction camps, transport (bringing workers and/or materials to the construction sites) and security.

*Induced employment and income generation*

The influx of construction workers and/or the increased disposable income available to the local workers employed on the Project will have a minor multiplier effect on the economy of the towns and settlements situated along the route of the pipeline. There may be an increased demand for rented accommodation, meals and general services, such as the provision of food to the caterers at the construction camps, production of clothing for workers, maintenance of vehicles etc. Potential negative impacts from this uplift in the
local economy could be localised inflation or increased scarcity / costs for specific goods.

As discussed in Section 7.3.12, TAP AG will attempt to avoid locating worker camps close to communities wherever possible and assess the available resources and services before the start of the construction phase. This will help to minimize local inflation effects but may also mean that induced economic impacts are minimal.

### 7.3.11 Infrastructure

**Crossing of Existing Infrastructure**

Given the length of the pipeline, several crossings with existing infrastructure networks will be necessary including energy lines, telecommunication cables, irrigation channels, water pipelines, sewerage network etc. The Project will establish measures to cross these networks safely and with minimal disruption to the utilities they supply to people in the area.

The Public Power Corporation (PPC) has been engaged with during the route refinement process and will be engaged with further during the ESIA and construction preparation activities on matters including analytical information and the technical and safety requirements associated with crossing the transmission lines.

Consultation will also take place with the operators of the remainder of the transmission networks, in order to identify all crossings with existing transmission lines.

Once the identification process is complete TAP AG and the operator of each network will agree on the appropriate crossing method. Such crossings are relatively common practice and several techniques are available to ensure the protection of both the existing infrastructure and the pipeline.

Crossings with other pipelines, i.e. the fuel or sewage network will also be undertaken in consultation with the operators with crossings occurring above or below these existing structures depending on depth, safety issues and the method used for crossing. Again such crossings can be achieved without impact to the existing pipelines.
Crossings with irrigation channels will also be undertaken using an open-cut technique. This will result in short term (estimated to be a few days) disruption to the irrigation system depending on the size of the channel. However, due to the time scales involved, it is expected that alternative systems can be used to irrigate crops etc. Following construction as part of the reinstatement process the irrigation channels will be fully restored.

Crossings of the transport network such as major roads or railway lines can be implemented without any impact to the network or minimal disruption. This is achieved by using a technique known as thrust-boring, which foresees the construction of a tunnel underneath the road or railway and ensures that the operation of the transport network is not affected by construction works.

Minor roads will be crossed by the open-cut technique, which includes removal of the road surface material (asphalt or gravel) at the crossing area, construction of the pipeline trench, installation of the pipeline and reinstatement of the road in its former condition according to existing specifications. Traffic will be diverted to neighbouring roads during construction activities resulting in localised disruption to road users.

In order to ensure the safe crossing of all existing infrastructure the following mitigation measures will be considered:

- Consultation with the competent authorities and operators of the network to address safety and operational issues associated with the crossings; and

- Consultation with the users of the network where supply will be disrupted for example the irrigation network to ensure awareness around the disruption and availability of suitable alternatives if needed.

**Impacts due to Road Movements**

Vehicle movements, road crossings and construction works associated with the Project may have temporary impacts on transport infrastructure along the planned pipeline route. Diversions of local traffic and increased congestion in more heavily populated areas could have minor impacts on the local economy. In addition, the increased presence of heavy construction equipment could have a negative impact on the condition of roads.
As discussed in Section 9, TAP AG will consult with local authorities and users and plan construction works to minimise short-term impacts on local economies.

In addition, TAP AG will assess infrastructure upgrade requirements in collaboration with stakeholders that will benefit local communities (e.g. access roads, social facilities and health care facilities) in line with TAP AG’s Strategy for Social and Environmental Investments. Hence, it is expected that the Project may have a net positive impact on transport infrastructure in the medium to long term, with positive implications for the local and regional economy.

In some cases there will be a need to improve or construct access roads leading to the Protection Strip of the pipeline. In the case of roads that remain in place, these can be used by other traffic and will improve the transport network in the Study Area.

7.3.12 Presence of Workforce

The presence of an outside workforce during construction could have a number of impacts on local communities in the immediate area. Some of these potential impacts include:

- Increased spending on local goods and services (discussed in Section 7.3.10);

- Impacts on local customs, norms and social institutions with implications for the cohesion of the local community;

- The potential for conflict between local residents and the workforce living in temporary camps – e.g. risks of fights, accidents – resulting in increased pressure on local services (leisure, police, etc.); and

- Increased transmission of diseases most notably communicable diseases and sexually transmitted infections with associated increased pressure on health infrastructure.

The construction of the pipeline is not concentrated in a single place but is continually moving from one site to another. Since the work requires several teams on each front and a number of fronts may be working simultaneously, it
is expected that the contractor(s) will bring the workers to the construction sites on a daily basis, bussing them in from local worker camps or from nearby towns or settlements. In this case the workforce is less likely to have a negative impact on settlements along the route of the pipeline; indeed many of the less specialised workers could be hired locally and will live at home.

TAP AG will also minimize the negative impacts associated with an outside workforce by requiring contractors to implement a strict “code of conduct”, worker management policies and prevention measures covering public health and safety issues along with respect for the environment and respect for local people. Access will be provided to recreational, social and health facilities, either at construction camps or through agreements with local facilities, to minimise pressure on local facilities and population. The application of a “code of conduct” will be contractually binding and will be described in the tender documents and included in the contract drawn up between TAP AG and the main contractor.

Finally, an effort will be made to avoid locating worker camps close to communities and to introduce the above mentioned Camp Management Plans and Worker Codes of Conduct with appropriate disciplinary procedures for any breaches.

7.3.13 Community Health and Safety

Potential impacts on community health and safety during construction include an increase in road traffic resulting in an increased risk of road traffic accidents, a decrease or perceived decrease in environmental quality including increased noise and decreased air quality due to dust and traffic fumes. Many of these impacts can be addressed thorough the implementation of appropriate mitigation and consultation.

Road traffic and Road Traffic Accidents

The main public safety issue during construction relates to the potential for road accidents involving Project related vehicles.

The Project will result in increased traffic, in particular increased movements of heavy goods vehicles, on roads near the pipeline construction corridor. This will include movements of excavators and bulldozers, cranes and other lifting gear, trucks carrying building materials and buses or minibuses carrying workers to and from the construction sites. The increase in the number of
movements could increase the possibility of road traffic accidents with non-Project related vehicles and pedestrians resulting in injuries and even death. It should be noted that normally there is little traffic in rural settlements in the region. This accentuates the risk because children and others are not used to traffic. Increased traffic can also result in community severances resulting in decreased access to social networks, livelihoods and social infrastructure, with impacts on wellbeing.

The risk of negative impacts of increased traffic can be reduced by implementing a number of mitigation measures related to traffic management. These will be outlined in detail in a Journey Management Plan and Community Safety Management Plans developed for the Project but typical measures include:

- Selecting a preferred transport route in consultation with the municipalities;
- Upgrading roads and/or junctions if required;
- Providing replacement crossing points;
- Avoiding settlements, schools and hospitals where possible;
- Restricting hours of movement to avoid peak times;
- Vehicle maintenance measures;
- Setting in place appropriate speed limits;
- Drug and alcohol testing;
- Driver training; and
- Community awareness and road safety training.

Furthermore a grievance mechanism has been established by TAP AG which will continue throughout the construction phase to allow local communities to submit grievances, issues or concerns associated with traffic movements.


**Decreased Environmental Quality**

Construction activities in the area could result in decreased environmental quality with associated impacts on the health and wellbeing of the population including annoyance. Typical impacts include increased noise, decreased air quality and an increase in dust with the potential for impacts on respiratory and cardiovascular diseases, sleep disturbance and annoyance.

Such issues are frequently mitigated through environmental controls as part of the environmental management and mitigation plan and through siting of equipment etc. For example dust may be a problem in some areas during the summer months, especially where heavy traffic is moving along dirt roads. Dust suppression techniques can be utilised such as water spraying – although this may make the roads slippery and perhaps more dangerous for light vehicles. Controls required for noise, dust and traffic fumes will be included as requirements in the tender documents to contractors.

In addition to address any perceived changes in environmental quality or other issues associated with the presence of construction activities a Grievance Procedure has been established by TAP AG which will run throughout the construction and operation activities.

**Site Security**

Poorly secured sites result in the risk of accidents and injury to local communities if they stray or trespass onto the site. As such, adequate security will be provided during construction at all sites: where appropriate temporary fencing will be provided to prevent livestock and people straying onto the sites.

Security personnel will also be employed during construction to prevent people and animals from entering the site and to discourage the pilfering of materials. In order to avoid human rights impacts the security guards will need to receive adequate training in dealing with the situations that are likely to arise. In particular they will be trained to react appropriately to minor incidents.

### 7.3.14 Labour and Working Conditions

During the construction works activities there is an increased risk of injuries to the workforce at sites with major excavations, tunnelling and working in the vicinity of active roads. TAP AG will develop an HSE management system for the Project in accordance with international good practice which will identify
risks to worker health and safety. Additionally, good site management practice will be implemented to reduce health and safety risks.

In order to ensure that the workforce is treated fairly, TAP AG will abide by all relevant legislation related to labour and working conditions and implement appropriate standards and policies related to workers conditions including hiring policies, grievance mechanisms for workers etc. These requirements will be included in all contractor agreements.

7.4 POTENTIAL IMPACTS AND MITIGATION DURING OPERATION

7.4.1 Biodiversity and Nature Conservation

Habitat loss

As described previously, the pipeline construction zone will be fully reinstated post construction, in all cases but forest land. Where forest is being crossed by the pipeline, a 8 m corridor above the pipeline will remain clear for safety reasons and no deep rooting vegetation will be allowed to establish along this corridor.

Impacts to flora and fauna may arise from the routine maintenance/clearance of the inner safety corridor. The implementation of a Vegetation/Landscape Management Plan will minimize any potential impact of the pipeline corridor.

Disturbance

The compressor station is a stationary noise source for the 20 BCM phase, which however will be limited within the regulatory requirements that apply for the protection of human health and nuisance to the neighbourhood. Typically, fauna is not usually disturbed by constant industrial background noise sources.

A more relevant source of disturbance during Project operations will occur from routine maintenance patrols along the pipeline route and at block valve stations by personnel in car or on foot. Also, periodic noise disturbances will occur from helicopter overflights being undertaken at certain intervals as part of the operational maintenance checks of the pipeline Protection Strip and
structures. Maintaining the safety strip clear of vegetation will be another source of disturbance.

The ESIA will identify sensitive sections of the route and certain seasonal constraints when maintenance and patrol activities should be restricted, for example, to avoid notable bird areas during the breeding season.

The development of the ESMMP during the full ESIA phase, and the design of a Biodiversity Action Plan (BAP) to be implemented for the lifetime of the Project will set out specific actions to avoid, mitigate and monitor any potential impacts on sensitive species and habitat.

Potential impacts arising from noise will be described in detail in Section 7.4.6.

### 7.4.2 Landscape

After the installation of the pipeline, subsoil and topsoil associated with the affected farmland will be reinstated as part of the construction process. Farming activities should be able to resume very shortly following construction, basically with the next growing cycle, and the farmland within the pipeline corridor will, over time, revert to its former cultivated appearance. Thus impacts on landscape character associated with the proposed pipeline during operation will be derived mainly from the associated above ground structure, such as the proposed block valve stations and compressor station which will be permanent features in the landscape. Additionally, a 8 m wide pipeline protection strip will be maintained where no deep rooted vegetation will be allowed to grow. This will be more evident in the forested areas. Clearing of seedlings and new undergrowth will be required along this corridor for the operational lifetime of the Project.

The Vegetation/Landscape Restoration Plan, developed during the ESIA stage, will focus on areas with high visibility or where special re-vegetation techniques should be established, which primarily applies to the compressor station and measures to shield views by vegetation screens. Aftercare for vegetation planted as part of the restoration efforts will be required for a number of years post-planting to ensure establishment.
7.4.3 Water Environment-Surface Water

The monitoring of surface water quality (defined in the ESMMMP), reinstatement of channels to pre-construction status and appropriate audit management will be put in place in order to mitigate any impacts to water environment.

During the operation of the pipeline no impacts are anticipated on the water environment.

7.4.4 Geology, Soils and Contaminated land

No impacts to soil are expected during Project operation and decommissioning activities.

7.4.5 Air Quality and Climate

Impacts to air quality and the local climate may result from emissions from regular operation during the 20 BCM phase. These relate to NOx, since the turbines that provide the energy to drive the compressors run on natural gas (Due to the composition of the natural gas and the envisaged combustion technology, neither sulfur nor dust are relevant emissions).

The compressor station may, during exceptional events, vent natural gas directly to the atmosphere to relieve overpressure.

For the purpose of this PEIA, air emissions dispersion modelling\(^1\) was undertaken to provide an initial assessment of the impacts on the airshed resulting from main emission sources (i.e. the gas turbines). The detailed modelling report is provided in Annex VII. The air dispersion model for the purpose of PEIA was based on technical concept information available at this stage. The model has used a conservative approach: It has considered air emissions that would occur at the full system capacity case of the pipeline system, i.e. 20 CBM/y and it has assumed that the compressor station CS02 would be running continuously at full load. In terms of air emissions this scenario represents the so-called worst case, and thus results are considered to be on the safe side (i.e. rather even overestimating the impact). CS02 is located in a region with only rural background and no other significant point source in the vicinity. Table 7-2 shows that the annual average NO\(_x\)

\(^1\) The air quality simulations were carried out with the CALMET/CALPUFF software
concentration contribution of the compressor station is negligible (i.e. less than 1 μg/m³); also the maximum hourly concentration that are reached at 99.8% of all hours of the year reach only approximately 20% of the relevant Greek / EU limit value. Compared to the low to moderate existing ambient background concentrations in the airshed of CS02¹, also in combination, no significant levels are anticipated. The CO concentration contribution of the compressor station is insignificant. (Details on background levels and modelling results see Annex VII).

Table 7-2 Summary Results of Air Emission dispersion Modelling for CS02

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CS02 * [μg/m³]</th>
<th>2008/50/EC Limit [μg/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOₓ Annual Average Concentration</td>
<td>0.8</td>
<td>40 (²)</td>
</tr>
<tr>
<td>NOₓ 99.8 % Percentile of Hourly Average Concentration</td>
<td>45</td>
<td>200 (²) (³)</td>
</tr>
<tr>
<td>CO Maximum Daily 8 Hours Mean Concentration(¹)</td>
<td>130</td>
<td>10000</td>
</tr>
</tbody>
</table>

(¹) The maximum daily eight hour mean concentration will be selected by examining eight hour running averages, calculated from hourly data and updated each hour. Each eight hour average so calculated will be assigned to the day on which it ends i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on that day.

(²) It corresponds to the hourly limit value for the protection of human health not to be exceeded more than 18 times a calendar year

(³) Limits Foreseen for NOₓ

In summary, the results of the dispersion model show that the operation of compressor station CS02 is not anticipated to cause significant adverse impact on air quality at relevant receptors, i.e. the settlements in the airshed of the compressor station. Detailed results are presented in the respective receptor related tables and the countour maps of the pollutant concentration in Annex VII. Further modelling studies are foreseen for the ESIA, talking into account further detailed information that will be available at later stage and including further assessments of background data and other major sources identified in the area.

(¹) ¹ according to published monitoring station data: about 10 – 20 μg/m³ in the CS2 region (details see Annex VII)
Facility maintenance and local air quality monitoring will assist in mitigating any potential impacts during operations, as well as the adoption of Best Available Techniques (BAT) for the abatement of air pollutants.

### 7.4.6 Noise and Vibration

Noise emissions are not expected to be generated from the pipeline during Project operation, only from the operation of the compressor station.

The compressor station will fully comply with the limits imposed by legislation for environmental noise at the borders of the facility, as set out in Presidential Decree 1180/81 (GG 293/A/6.10.81) as presented in Table 7-3:

#### Table 7-3 Noise Level Limits

<table>
<thead>
<tr>
<th>Area</th>
<th>Maximum noise level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Established industrial areas</td>
</tr>
<tr>
<td>2</td>
<td>Areas where the industrial element is dominant</td>
</tr>
<tr>
<td>3</td>
<td>Areas of mixed industrial and urban elements</td>
</tr>
<tr>
<td>4</td>
<td>Areas where the urban element is dominant</td>
</tr>
</tbody>
</table>

Measures to be implemented to ensure full compliance will include:

- Maintenance and monitoring;
- Noise emission monitoring;
- Location of compressor station away from sensitive receivers;
- Modelling of main noise emission sources (generators, compressors);
- Monitoring of main emission sources (generators, compressors);
• Using specific mitigation on noisy equipment (acoustic shielding);

• Locating noisy equipment (compressors) away from noise sensitive receptors.

7.4.7 Use of Resources and Generation of Waste and Refuse

Waste and wastewater may result from the operation of the compressor station and by the block valve stations during maintenance. This includes waste generated by pigging operations (tailings and sludge) and gas filter systems in the compressor station.

A detail Waste Management Plan will be developed during the full ESIA stage. In this plan all issues of waste and wastewater handling and disposal will be described and addressed in detail.

7.4.8 Cultural Heritage

No specific impacts or risks are expected during the operation (land take and earth works limited to construction phase). All specific details of ground disturbing removal and restoration activities during decommissioning will be fully defined and explained in the Cultural Heritage Management Plan (including ICH) which will be developed during the full ESIA stage.

7.4.9 Land Use

The route selection process has aimed to reduce areas of conflict with land uses. However, land use will be permanently restricted along the safety zone of the pipeline to protect the integrity of the pipeline and provide for safety distances to other uses, according to the TAP standards:

• A permanent safety strip with a width of 8 m will be established (i.e. 4 meters either side of the centreline). The cultivation of field crops will not be restricted, but the safety strip has to be kept free from any cultivation of plants with deep routing system such as olive and fruit trees, or any other bushes or trees.

• The construction of new structures will be restricted in a corridor of maximum 60 m (i.e. 30 metres to both sides of the centre line) and the establishment of cluster of houses and/or industrial infrastructure in a
corridor of maximum 200 m (i.e. 100 metres to both sides of the centre line). The preferred route was selected considering this constraint and distance to settlements allows sufficient space also for future developments of communities neighbouring the pipeline.

- Additionally, land use restrictions in the near surrounding of the compressor station may apply triggered by risk protection requirements. The foreseen extend of the fenced compressor station premises of approximately 40 hectares which will be purchased by TAP AG, already includes a safety buffer. Results of further risk studies will inform if additional safety distances and restrictions on land use around the compressor station will be required.

Several measures will be implemented to ensure that no impact will arise from the operation of the pipeline to land uses, property or people. The Livelihood Restoration Action Plan will consider impacts to land during operation and decommissioning and provide for compensation to land owners/users. The *livelihood restoration plan* will assure that these restrictions do not result in the impoverishment of the people owning and/or using these lands. Any compensation will be compliant with Greek regulatory requirements and in line with the relevant EBRD Performance Requirement (PS5).

A *Land Restoration Plan* will be implemented to restore any project affected land for productive use after decommissioning of the project.

During operation, TAP AG will maintain the right to access the pipeline for inspections and maintenance but ownership of the land will remain with the original owner. The land will be returned to its original use except for the cultivation of plants with deep routing system such as olive and fruit trees.

The land acquisition for the above ground infrastructure i.e. the compressor station and block valve stations will have been undertaken prior to construction.

Several measures will be implemented to ensure that no impact will arise from the operation of the pipeline to land uses, property or people. The Livelihood Restoration Action Plan will consider impacts to land during operation and decommissioning and provide for compensation to land owners/users.
A land restoration plan will be introduced to restore any Project land for productive use after decommissioning of the Project.

TAP AG is going to engage a team of Community Liaison Officers (CLOs) to manage and monitor TAP AG’s community relations and restoration plans and will undertake engagement with the communities along the route as part of the stakeholder engagement plan.

7.4.10 Economy and Employment

Economic and employment impacts during operation of the pipeline are possible at the national, regional, municipal and local level.

Benefits at the national, regional and municipal level will result from increased government revenues as a result of tariffs on gas transport.

Economic benefits to the local economy may arise from limited direct/indirect job creation during operation of the pipeline. Individuals of companies may benefit from employments and procurement opportunities associated with the compressor station, maintenance etc.

To optimize opportunities for local companies and people, TAP AG will implement the local content strategy developed for the Project, and ensure that there is a fair and transparent recruitment process. Wherever this is possible, TAP AG will procure goods from local suppliers through sub-contracts to local firms (subject to availability, quality and cost) and purchasing of goods from local retailers.

Potential negative impacts may arise from land use restrictions on new structures (permanent and semi-permanent buildings such as greenhouses and infrastructures) for safety reasons. The construction of structures will be restricted in a corridor of maximum 60 m and the establishment of cluster of houses and/or industrial infrastructure in a corridor of maximum 200 m.

7.4.11 Existing Infrastructure

No impacts are anticipated to existing infrastructure in the operation phase of the Project.
7.4.12 Community Health, Safety and Security

Traffic related impacts

Traffic operation related to Project operation activity might impose limited safety risks and severance in local communities currently using and living along the roads to be transited by the Project vehicles, including mountain roads.

As for the construction phase, appropriate Journey Management Plans and Community Safety Management Plans will be developed to address impacts associated with road safety.

Any severance between access to/from people’s homes and infrastructure, and places of work including agricultural land and in some cases grazing areas will be addressed through providing safe crossing points.

Presence of Workforce related Health, Safety and Security aspects

The presence of an outside work force could have a number of impacts on local communities in the immediate area. Some of these potential impacts include increased consumption on local goods and services; impacts on local customs, norms and social institutions with implications for the cohesion of the local community, e.g in case of workers misbehaving, abuse of alcohols or drugs. TAP AG will address these issues and minimize potentially negative impacts associated with an outside workforce by requiring contractors to implement a strict “Code of Conduct”, worker management policies and prevention measures covering public health and safety issues along with respect for the environment and respect for local people. Attention will also be given to minimise phenomena that are known to occur from the temporary presence of large workforce, such as the potential risk of sexual transmitted diseases.

Potential impacts and risks for community health and safety will be addressed through the implementation of appropriate mitigation in consultation with the relevant authorities and local administrations based on specific traffic risk assessments, and health impact assessments which are integrated into the ESIA.
Operational Safety

For operation of the pipeline system, emergency response plans will be developed. Emergency response capacities and infrastructures (fire brigades, hospital equipment etc.) may also be enhanced as needed with the support of TAP AG based on this plans. All plans will be developed in compliance with Greek regulatory requirements, the relevant EU framework, and the relevant Performance Requirement of the EBRD (PR4).

The Project will comply with a range of safety-related legislation throughout the design, construction and operational phases. Internationally recognised design codes and standards will be adopted as appropriate for the design, construction and operation of the Project.

An assessment of the major hazards associated with the Project will be carried out, together with a quantitative risk assessment (QRA) based on the conceptual engineering design. This analysis will cover major hazards. The following tasks will be performed in support of this study:

- Hazard Identification (HAZID) study to systematically review the layout and operation of the site to identify potential release sources, together with their causes and the associated safeguards to prevent or mitigate major accidents. The method focuses specifically on major accident scenarios.

- Estimation of event frequencies by determining the individual failure rates and failure modes of the different equipment items. The failure rates and failure modes will be obtained from public and proprietary databases and consistent.

- Consequence assessment to determine maximum harm ranges for each hazardous event identified.

- Risk analysis and assessment will combine the frequency and consequence data to determine the risks to offsite populations. Risk results will be generated to include individual risk contours, risk ranking prioritisation tables or charts, societal risk graphs for on-site and offsite areas/populations/buildings, and contour plots showing the frequency with which damaging levels of blast or thermal radiation are experienced, as appropriate. The results will be compared against HSE risk criteria for land-use planning and risk tolerability.
As a result of the inherent in-built safety measures, gas pipelines have been demonstrated to provide an acceptably safe means of transporting gas, although there is inevitably a small residual risk attached to the operation of such a pipeline. As a result of these studies the proposed pipeline will meet the levels of risk which are considered acceptable to society.

7.5 LABOUR AND WORKING CONDITIONS

A detailed Health and Safety management system will be designed and implemented according to international good practice, where risks for workforce health and safety will be identify and addressed. Additionally, in order to reduce health and safety risks during the operation of the pipeline and compressor station, good site management practices will be applied such as appropriate training and staff qualification, and appropriate work standards.

In order to ensure that the workforce is treated fairly, TAP AG will abide by all relevant legislation related to labour and working conditions and implement appropriate standards and policies related to workers conditions including hiring policies, grievance mechanisms for workers. These requirements will be included in all contractor agreements and will refer to Greek regulatory and EU framework and the relevant Performance Requirement of the EBRD (PR2) and reflect the relevant sections of TAP’s CSR policy that contain inter alia the commitment to assure compliance with core labour standards of the International Labour Organisation (ILO), the voluntary principles of security and human rights. TAP AG will assure compliance of labour related topics by the contractors through monitoring.

7.6 IMPACTS FROM DECOMMISSIONING

Any decommissioning activities will be carried out according to the state-of-the-art and best practice available at that time and the need to avoid or minimise any impacts, e.g. from dismantling of installations. Current practice is to keep pipelines in the ground and not recover them. However this practice might well change if the value of scrap steel increases and it becomes economically viable to salvage. Dismantling impacts will then be similar to construction impacts.
7.7 CUMULATIVE, COMBINED AND SECONDARY IMPACTS

Cumulative impacts are effects where the Project is taking place at the same time as other developments and they have cumulative effects on the same receptors and resources. Combined impacts are effects that arise from the combination of different effects on specific resource or receptor e.g. noise, dust and traffic congestion all affecting the same group of residents.

Cumulative and combination effects may result from various types of interaction:

- A combination of different types of effects at a specific location (which may result from different elements of the Project such as the pipeline corridor, compressor station);

- A combination of effects of the same type at different locations, which are not necessarily significant individually, but which collectively may constitute a significant effect;

- The interaction of different effects over time; and

- The cumulative interaction between effects from the proposed development and other existing or planned projects in close proximity; and

- Combination effects and the interaction effects from the different project elements will be taken into consideration within the technical scope of the ESIA and will be reported where appropriate within each topic chapter.

Other existing developments which may have cumulative impacts within the area of influence for this Project, will be considered and their environmental and social impacts will be taken into account in defining the baseline for the assessment. The cumulative effects of these projects with those of the proposed development will therefore be incorporated into the assessment.

To date the Project team has identified other activities which may have parallel construction with the TAP Project within the Study Area of influence. Two particular planned projects of note include:

- Public Power Corporation quarrying activities; and
- Public Power Corporation, the future works for the transfer of PPC substation in the area of Kardhia which will require relocation of many high voltage lines.

7.8 **TRANSBOUNDARY IMPACTS**

Based on the present information the potential impacts of the Project will not affect neighbouring countries except Albania that will as well be affected by the project directly.

7.9 **PREPARATION OF THE FULL ESIA**

Table 7-4 provides an outline of the proposed contents of the ESIA Report, with an explanatory note for each section provided. The content may change through the evolution of the Project but is anticipated to accord broadly with this framework.

**Table 7-4** Outline of the Proposed ESIA Contents

<table>
<thead>
<tr>
<th>Chapter Number</th>
<th>Contents Heading</th>
<th>Explanatory Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Piece</td>
<td>Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps)</td>
<td></td>
</tr>
<tr>
<td>Executive Summary</td>
<td>Summary of the entire ESIA report.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction</td>
<td>This Chapter will outline the development and structure of the ESIA report including the background, scope, terms of reference and declaration.</td>
</tr>
<tr>
<td>2</td>
<td>Project Justification</td>
<td>This Chapter will include discussion of the Project background, objectives, need for the Project, value of the Project, envisioned sustainability, alternatives considered (including no project alternative), development options considered and site selection.</td>
</tr>
<tr>
<td>Chapter Number</td>
<td>Contents Heading</td>
<td>Explanatory Note</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>3</td>
<td>Legislative and Policy Framework</td>
<td>This Chapter will outline the policy, legal and institutional framework within which the ESIA has been conducted. National regulations will be summarised along with relevant international agreements and conventions to which Greece is party, as well as applicable international best practice guidelines and project standards.</td>
</tr>
<tr>
<td>4</td>
<td>Project Description</td>
<td>This Chapter will provide a concise description of the Project and its geographical and temporal context. It will include a site description, an overview of the Pipeline Project design and details of Project inputs and outputs.</td>
</tr>
<tr>
<td>4</td>
<td>Description of the Environment</td>
<td>This Chapter will summarise the available baseline data on the environmental and social resources and receptors within the Project Study Area. It will be based on both primary and secondary data sources and will consider changes in the baseline condition without the development in place.</td>
</tr>
<tr>
<td>5</td>
<td>Consultations and Disclosure</td>
<td>This Chapter will present the results of consultation undertaken as part of the ESIA, plus plans for future consultation. It will identify key Project stakeholders and present their feedback on the TAP Project.</td>
</tr>
<tr>
<td>6</td>
<td>Associated and Potential Impacts</td>
<td>This Chapter will summarise the predicted positive and negative impacts of the Project. Cumulative impacts will be assessed as appropriate.</td>
</tr>
<tr>
<td>7</td>
<td>Mitigation and Residual Impacts</td>
<td>This Chapter will outline general and specific mitigation measures to reduce, remove or avoid negative impacts to environmental and social receptors. Any residual impacts (post mitigation) will be outlined.</td>
</tr>
<tr>
<td>8</td>
<td>Environmental and Social Management Plan (ESMP)</td>
<td>The ESMP will draw together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation; and estimate the costs of the measures.</td>
</tr>
<tr>
<td>9</td>
<td>Conclusion</td>
<td>This Chapter will summarise conclusions that are made based on the assessment as well as outline any further recommendations.</td>
</tr>
<tr>
<td>Chapter Number</td>
<td>Contents Heading</td>
<td>Explanatory Note</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Bibliography and References</td>
<td>All references made in the report and documents drawn upon during the course of the assessment</td>
<td></td>
</tr>
<tr>
<td>Annexes</td>
<td>These will include technical annexes with details of specific technical surveys, the bibliography and list of acronyms.</td>
<td></td>
</tr>
</tbody>
</table>
8 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

An Environmental and Social Management and Monitoring Plan (ESMMP) will be prepared for the Project, as part of the ESIA. The main objective of the ESMMP is to:

- Provide a framework for continuing compliance with relevant Greek legislation and relevant international standards;
- Ensure that best industry practice is adopted throughout the construction, commissioning, operation and decommissioning of the pipeline;
- Provide a mechanism for ensuring that measures to mitigate potentially adverse environmental and social impacts are implemented;
- Provide a framework for mitigating impacts that may be unforeseen or unidentified until the Project is underway;
- Provide assurance to third parties that their requirements with respect to environmental and social performance will be met; and
- Provide a framework for compliance auditing and inspection to enable TAP AG to be assured that its aims with respect to environmental performance are being met.

The ESMMP will be a document that continuously evolves throughout the life of the Project. It will be developed as further consultation and route investigations take place, and detailed design and working method statements are prepared. The ESMMP will contain:

- A statement of the environmental and social aims and policy objectives of the Project;
- Relevant legislation and regulations;
- A summary of the potential residual impacts (both positive and negative) on environmental and socio-economic resources affected by the Project as identified through the ESIA; and
A schedule / commitment register of environmental and social mitigation measures that will be implemented.

As detailed design proceeds, the ESMMP will continue to evolve and will be developed to include, for example:

- Roles and responsibilities of key individuals;
- Environmental awareness programs;
- A reinstatement and restoration plan;
- Environmental monitoring specifications; and
- Inspection and auditing programmes.

A number of issue specific management plans will also be prepared along with the ESMMP. Key management plans that are expected to be prepared include, but are not limited to:

- Emergency response plan;
- Waste management plan; Traffic management plan;
- Procurement and supply chain plans,
- Employment and training, and
- Landscape management.

Any detailed working method statements produced by the Contractor, and the subsequent construction and restoration practices, will be developed by:

- An iterative process between environmental specialists, and the Contractor at the planning and detailed design phase; and
- The provision of ongoing advice and supervision by TAP AG’s management team who will be responsible for monitoring, inspection and audit functions through the construction and restoration phases.
An indicative structure for the ESMMP is provided below:

Section 1  Introduction

Section 2  Environmental and social impact assessment (ESIA)

Section 3  Purpose of the ESMMP

Section 4  Development of the ESMMP

Section 5  Monitoring programme

Section 6  Roles, responsibilities and reporting

Section 7  The role of TAP AG with respect to environmental and social management

Section 8  The role of the contractor with respect to environmental and social management

Section 9  Third party communication plan and procedures
9  PUBLIC CONSULTATION

9.1  STAKEHOLDER ENGAGEMENT PLAN

This Section presents the stakeholder engagement process for the TAP in Greece – the ‘Project’. TAP AG has developed a Stakeholder Engagement Plan (SEP) for the Project in line with Greek Legislation and the European Bank for Reconstruction and Development (EBRD) Performance Requirements on Environmental and Social Impact Assessment.

The main goals of the SEP are to ensure that:

- Adequate and timely information is provided to Project-affected people and other stakeholders;

- Stakeholders are given sufficient opportunity to voice their opinions and concerns; and

- Stakeholder feedback influences Project decisions.

The SEP is a living document, which will be regularly updated throughout the Project. Engagement activities undertaken during the initial phases of the Project are being used to define engagement going forward. Annex IV presents the current version of the SEP.

The SEP includes the public information and consultation requirements of the regulatory EIA in Greece. The Greek requirements for consultation are based on the respective EU framework (Directive 2003/35EC). As TAP AG is also complying with the EBRD Performance Requirements and its internal corporate requirements, additional information disclosure and stakeholder engagement is being undertaken for the Project.

The main supplementary elements to the legally prescribed process in Greece are to: undertake focussed stakeholder engagement activities and incorporate feedback received in the route refinement process; and to disclose and consult on a Scoping Report prepared in line with EBRD requirements.

Ongoing engagement activities are planned following submission of this document (the Preliminary EIA (PEIA)) and throughout the ESIA process.
9.2 **STAKEHOLDER IDENTIFICATION, ANALYSIS AND MAPPING**

For the purposes of this plan and according to EBRD Performance Requirements (PR 10, point 8) stakeholders are individuals or groups that are affected or likely to be affected (both directly and indirectly) by the Project (“affected parties”) or that may have an interest in the Project (“other interested parties”).

The objective of stakeholder identification is to establish which organizations and individuals may be directly or indirectly affected (positively and negatively) by the Project. The process also aims to identify which stakeholders may have an interest and/or an influence on the Project.

Stakeholder identification and mapping was initiated during the Project planning phase and will be regularly reviewed and updated throughout the life of the Project. An initial list of categories of stakeholders and their level of engagement at each stage of the development of the Project are listed in Annex V of this document. Additional stakeholders will be added to this list as they are identified.

9.3 **PHASES OF STAKEHOLDER ENGAGEMENT**

For the purposes of this Project, the Stakeholder Engagement Plan has been divided into five phases, each having slightly different objectives for consultation.

These five phases are:

- **Phase 1: Pre-Scoping.** This Phase has been completed and consisted of high level strategic engagement with government departments and key informant groups, in order to provide information about the Project, gauge its viability and identify any key issues early.

- **Phase 1: Route Refinement:** The overall objective of stakeholder engagement during the pipeline route selection process was to identify sensitivities that needed to be taken into account when selecting the preferred route. During this phase the Project was introduced to national, regional and local authorities and a sample of potentially affected communities, to gather baseline information and identify any key issues
and sensitivities such as sites of interest, presence of vulnerable groups etc. Consultation was undertaken between October 2010 and March 2011.

- **Phase 2: Scoping Consultation.** Engagement activities will be carried out on the Scoping Report during June 2011 in order to inform stakeholders about the route selection and project design and to understand any issues which may inform the ESIA Terms of Reference (ToR) and the development of mitigation measures for the Project. During this phase TAP AG met with national, regional and municipal stakeholders and Heads of Local Communities, as well as NGOs, in the Study Area and in Athens.

- **Phase 3: ESIA Consultation.** The Project will continue to engage national, regional and municipal stakeholders as well as NGOs. Additionally, alongside social baseline data collection, the Project will hold ESIA consultation meetings in each settlement with land inside the 2 km pipeline corridor. All stakeholders will be provided with a project update and an opportunity to comment, express any concerns and discuss issues. All feedback related to potential impacts of the Project will be considered in the ESIA and the manner in which this feedback influences the ESIA will be documented. The Project team will also ensure that stakeholders are familiar with the grievance mechanism and provided with information on the next phases of the Project.

- **Phase 4: ESIA Report Disclosure and Consultation.** Once the draft ESIA has been completed it will be publicly disclosed and engagement activities will be organised to present the findings of the ESIA and receive comments and suggestions. The disclosure and consultation will be organised at the national, regional and local level under the supervision of the Ministry of Environment, Energy and Climate Change (MEECC), Forests and Water Administration and the Regional Environmental Agencies. All administrative levels from regional to settlement representatives will be engaged as well as the local communities, NGOs and other interested parties.

30 days after the notification and disclosure of the ESIA report, TAP AG will hold public hearings (dates and locations will be identified and disclosed). The notification of the public hearings will be announced through the media and the hearings will be open to the public. Comments and suggestions made during the public hearings will be considered in the final ESIA report.
• **Phase 5: Ongoing Engagement.** TAP AG will continue to engage with stakeholders throughout the Project lifecycle. The methodology for this will be developed and finalised using the information compiled during the ESIA process.

Table 9-1 summarises the phases of the SEP Greece and the progress to date.

**Table 9-1  Phases of the SEP Greece and Progress to Date**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Objective</th>
<th>Status as of August 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternatives Assessment</td>
<td>To introduce the Project and identify environmental, social and cultural heritage sensitivities that should be taken into account in selecting the preferred route.</td>
<td>Completed</td>
</tr>
<tr>
<td>Scoping Disclosure and Consultation</td>
<td>To provide further detail on the Project and an opportunity for stakeholders to provide feedback on route selection and the scope, approach and key issues that will be addressed during the ESIA as well as the plans for future engagement activities.</td>
<td>Completed</td>
</tr>
<tr>
<td>ESIA Phase</td>
<td>To maintain the relationships developed during the previous stages; and ensure all stakeholder issues have been identified and taken on board by the Project. TAP AG will revisit national and regional authorities and engage with affected communities along the chosen pipeline route. All stakeholders will be provided with a project update and an opportunity to comment, express any concerns and discuss issues.</td>
<td>Sept-Oct 2011</td>
</tr>
<tr>
<td>ESIA Disclosure</td>
<td>To allow the Project to maintain the relationships developed during the previous stages; and ensure all stakeholder issues have been identified and taken on board by the Project. The Project will disclose the draft ESIA report and invite stakeholders to comment on the document. Information on the Project impacts will be presented along with mitigation measures.</td>
<td>Planned</td>
</tr>
<tr>
<td>Project Execution (construction, operation and decommissioning)</td>
<td>To continue engaging with stakeholders throughout the Project lifecycle. The methodology for this will be developed and finalised using the information compiled during the ESIA process.</td>
<td>Planned</td>
</tr>
</tbody>
</table>
9.4 **GRIEVANCE MECHANISM**

TAP AG has established a grievance mechanism in order to be aware of and respond to stakeholders’ concerns and to facilitate resolution of stakeholders’ grievances. The grievance mechanism will be used to address concerns promptly and effectively, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected parties, at no cost and without retribution.

The mechanism includes an independent, objective appeal mechanism, which will not impede access to judicial or administrative remedies. Through the SEP and other means, TAP AG will inform the affected parties about the grievance process and report regularly to the public on its implementation, protecting the privacy of individuals.

The grievance mechanism will supplement the process for community engagement. While TAP AG is committed to avoid grievances through its dedication to a good overall stakeholder engagement process, it is aware that grievances and complaints will occur and need to be addressed in good faith and through a transparent and impartial process.

TAP AG has established a Third Party Grievance Mechanism for the Pre-Construction Phase based on the preliminary consultations and as part of the SEPs in order to have the mechanism up and running before the beginning of the environmental and social assessment process.

More detail on the Grievance Mechanism design and procedure as well as the Grievance Process for the Pre-Construction Phase is included in the Overall SEP (Annex IV).

9.5 **TRANSBOUNDARY CONSULTATION**

The UN Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) stipulates the obligations of countries (referred to as Parties) to assess the environmental impact of a project at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on whether a project on their territory is likely to have a significant adverse transboundary environmental impact.
It is important to recognize that the disclosure of information and the engagement with stakeholders is between governments and government agencies and the public and not between the project developer and the public. However, parties of origin can ask the developer to undertake public consultation above and beyond their normal EIA requirements and the developer may also be asked to undertake public consultation in affected parties. Parties of origin and affected parties and their identification for the TAP Project are defined in Table 9-2. As shown, for the TAP Project, Affected Parties correspond to Parties of Origin.

**Table 9-2 Definition of Parties for the TAP Project According to the Espoo Convention**

<table>
<thead>
<tr>
<th>Party according to Espoo Convention</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parties of Origin</td>
<td>Albania, Greece and Italy</td>
</tr>
<tr>
<td>Affected Parties</td>
<td>Albania, Greece and Italy</td>
</tr>
</tbody>
</table>

The parties of origin for TAP Project (Albania, Greece and Italy) have ratified the Espoo Convention.

Key steps that should be followed under the Espoo Convention are:

- Screening (by the parties of origin) to assess if a transboundary EIA is mandatory under the convention;
- Notification by parties of origin to each other and to affected parties of the start of the Espoo Process;
- Exchange of project information between all parties;
- First round of public and inter-party consultation;
- Preparation of EIA documentation;
- Second round of consultation;
- Distribution of EIA documentation;
- Consultation among the Parties; and
• Final decision.

The Espoo Convention guidance recommends that public participation should be considered as one of the most important elements in a transboundary EIA and goes on to recommend responsibilities and requirements for the involvement of the public in the process (see Box 9-1).

**Box 9-1 Public Consultation in the Espoo Convention**

Best practice public consultation under the Espoo Convention (UN/ECE guidance on Public Participation in the Environmental Impact Assessment in a Transboundary Context, 2006) includes (but is not limited to):

**Participation of the public:**
- The parties of origin should support participation of its own public, as well as the public of the affected parties (Art. 2/6).
- The Affected Parties should support participation of its own public and where necessary carry out the procedures of the parties of origin (Art. 3/8).

**Opportunities for comment:**
- The opportunities given to the public of the Affected Parties must be equivalent to those provided to the public in the parties of origin (Parties of Origin and Affected Parties responsibility, Art. 3.8).

**Translation of documents:**
- The parties of origin are responsible for translating and distributing all relevant documentation (Art. 4/2).

**Collection of comments:**
- The affected parties are responsible for their collection, their analysis and their submission to the parties of origin (Appendix VI/e).

**Preparing the decision:**
- The parties shall ensure that, in the final decision on the proposed activity, due account is taken of the comments thereon received on the transboundary EIA. The parties of origin will then prepare the text of the decision, along with the main reasons and considerations on which the decision is based, and make this accessible to the public (Art. 6/1).

**Raising awareness amongst affected public:**
- Both the parties of origin and the affected parties should promote environmental education and training for the general public, specified target groups and competent authorities (Art. 9).
10 SAFETY MEASURES

10.1 INTRODUCTION

This Section summarises the key safety measures that will be implemented through the design, installation and operation of the Project pipeline system and compressor station sites.

10.2 PIPELINE SYSTEM

- The design of the pipeline will be in accordance with internationally accepted and proven industrial codes / design standards and construction methods.
- The pipeline will undergo a stringent route selection process.
- The pipeline will be coated with 3 overlays of PE combined with a corrosion protection system.
- The pipeline will be pressure tested after installation and prior to start-up
- Remote controlled block valve stations will be installed to sectionalize the pipeline and to limit the pipeline volume in the unlikely case of leakage.
- An Emergency Shut Down system will be installed
- The route of the pipeline will be appropriately marked and warning tape will be installed above the buried pipeline.
- Scraper traps will be installed to allow frequent internal pipe inspections using intelligent PIGs.
- A permanently manned control centre will be operated.
- The entire pipeline route will be frequently patrolled by air and/or ground vehicle.
10.3 **COMPRESSOR STATION SITE**

- The compressor station will be designed in accordance with EN standards.
- The design of the station will include, as a minimum:
  - inherent technical safety measures
  - an Emergency Shut Down (ESD) system
  - Fire and Gas detection systems
  - Overpressure protection systems
  - Fire Fighting System
- Permanent monitoring of all operating data at receiving terminal in Italy
- Pipes and pressurised parts/components will undergo regular inspection and maintenance procedures.
- Security measures (e.g. CCTV, appropriate fencing) will be installed at the compressor station site.
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